FLIGHT

and The AIRCRAFT ENGINEER

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The Outlook

Gloves Off

THINGS have been happening with bewildering rapidity since the last issue of *Flight* was published. Then the British forces had been withdrawn from the Aandalsnes district of Norway, and there was to be a debate on the Norwegian events in the House of Commons. Now Hitler has repeated his Danish and Norwegian tactics by "coming to the rescue" of Holland and Belgium in order to prevent them from being invaded by Great Britain and France; and we in this country find ourselves not only with entirely new strategical problems to tackle, but with a new Government to direct the process.

The country as a whole has received with something like relief the new phase upon which the war has entered. The static war was getting us no nearer, at least not visibly so, to a decision, and the reaction of the man in the street was a mixture of indignation that two more neutral countries had been set upon by the bullies, and a feeling that now at last we might begin the war in real earnest.

No fair-minded person will deny that Mr. Chamberlain had a most difficult task as Prime Minister. It is so easy for the Opposition to ask why we did not do this, that or the other. Now those who have shouted the loudest will be given a chance to see what they can do. But in all fairness to the previous Government it should be borne in mind that the stalemate which existed tied their hands a great deal. That the new Government, under Mr. Churchill, will wage a very different type of war has already become evident. But conditions have changed, and it is as well to realise that the invasion of the Low Countries, had it come before the change of Government, might well have kept Mr. Chamberlain in office.

That Mr. Churchill will strike, and strike hard whenever the opportunity offers, may be taken for granted. That he will make mistakes seems possible; the great pages of history were not written by men who made no mistakes. And if Germany thought to get a quick advantage by invading Holland and Belgium while the effete democracy on the other side was changing Government, she has been disappointed. The response of the Allies to the appeals of these countries has been as swift as it was effective.

A Difficult Task

WITH the political aspect of the Government changes we are little concerned. That all parties should be represented is only sound sense. But we view with some concern the frequent changes of Air Ministers which have occurred lately. It is all very well to argue that it is the Air Council as a whole which directs air affairs, and that so long as the service chiefs on the Council are the right men, it matters little who is president of the Air Council. But the personality of the Air Minister can go a very long way towards influencing air policy, and no man can learn to weigh impartially the conflicting claims put forward until he has obtained a very thorough insight into what is an extraordinarily complicated subject. It takes a clever man to do that inside a year, and Sir Archibald Sinclair is likely to be faced with problems which had not yet arisen when Sir Kingsley Wood handed over the Air Ministry to Sir Samuel Hoare.

Apart from the fact that the day of patrols over the North Sea as the chief activity of the R.A.F. is over, and that the Bomber Command is about to be given an opportunity of showing what it can really do, there will from now onwards be a much greater wastage in aircraft and personnel than hitherto. In some ways one might say that the war with Germany did not really start until Friday last. In other words, we may now see the war take the course which everyone expected it to take last September.

Great Britain and France have made great strides in their aircraft production programmes since then, but it is not to be expected that Germany has been standing still. Thus the problems of production, and they include the production of air crews, will be likely to become serious in the very near future. The new Air Minister carries the good wishes of the whole nation in his difficult task.

Our New Front

PURELY from the point of view of air war, the accession of Holland and Belgium to the ranks of the Allies is likely to have a profound influence on developments. Norway was too far away, and we arrived there too late to be able to stem the German advance on land. In the Low Countries it is a very different matter. They are so close to our shores that aircraft of a different class can be brought into play. Already it has been reported that the Boulton Paul Defiant has had its first encounters with the enemy; and even our single-seater fighters have sufficient range to play their part. That means that in future there is likely to be a good deal of scrapping between our fighters and those of the enemy.

From experience in France there is good reason to believe that at present our single-seater fighters, with their eight guns, are a match for anything Germany has produced so far. But it would be foolish to overlook the fact that Germany is well aware of this, and that she will strain every nerve to put into the air types which will be the equal of our fighters. That is all the more reason why this country must proceed at the utmost speed with the production of the new types of fighter so that they can be available in ample numbers as soon as it begins to become clear that the Hurricanes and Spitfires which have served us so well hitherto are no longer equal to the task.

Occupation Without Control

ONE feature which has been given great prominence in the war news is the use Germany is making of landing men by parachute. Russia tried this without much success in the Finnish war. Germany tried it with considerable effect in Norway. In fact, one official communiqué stated that these parachute troops "made merry with our communications."

In the Low Countries, with their very different geography, the scheme seems so far to have enabled the enemy to do a certain amount of damage, but an invasion by air is still outside the scope of practical politics. It was, we think, Sir Samuel Hoare who first used the expression, "Control without Occupation," about the work of the R.A.F. in the east. Germany's use of parachute troops is rather to be regarded as the reverse of this. Men landed in this way can do a good deal of damage at selected strategic points before they are rounded up, but they are not likely to hold out for very long.

"*Flight*" *photograph.*

THE GLADIATOR TAKES A BOW: After having flown to Norway from an aircraft carrier a squadron of Gloster Gladiator four-gun fighter biplanes (Bristol Mercury IX) shot down six German bombers, on an average 50 m.p.h. faster, and put eight more out of action. The machines operated from a frozen lake.

IN A GERMAN PRISON CAMP

French and British Air Crews Treated Well — and Why : The Stopped Smokes : Food from Home : Walking and Sleeping

One of the houses in which British and French prisoners of war are accommodated. The officers have their separate bedrooms.

A library is provided by the Commandant of the camp. Here two British officers are seen reading a copy of *Flight*.

Daily walks in the pleasant surroundings of the camp are permitted.

THE German weekly paper *Der Adler* of April 16, 1940, contained an article by Josef Grabler entitled "Im Lager der Abgeschossenem" (In the camp of those shot down), in which the life of French and British air crews is described. The accompanying pictures are reproduced from the German paper with due acknowledgment.

The article begins by pointing out that the air forces of the countries at war claim, as independent units of the Fighting Services, the enemy air crews that have been captured and put them in their own special camps with their own guards. The German *Luftwaffe* has taken the first step, and the Royal Air Force and l'Armee de l'Air have followed suit. These measures, by the way, amount to a right, as in most cases the enemy air crews have become prisoners owing to the action of the *Luftwaffe*. In the very nature of air war, fewer prisoners are taken than in the case of the Army. This fact means that conditions are more favourable for the whole system of treatment of the prisoners of war.

"In the last war" (the article continues) "the enemy countries were not very scrupulous in complying with

"The Compleat Angler". A captured R.A.F. officer tries his luck with somewhat primitive gear.

Another picture taken during one of the daily walks. The name of the Army officer is stated in the German journal to be Griffiths. The civilian is a German interpreter.

international law in the matter of prisoners. So, for instance, they kept prisoners after the armistice and after peace was declared. In the present war, however, the enemy countries, too, have realised that the treatment of prisoners is a question of reciprocity (Gegenseitigkeit). 'Wie du mir, so ich dir,' which may be translated: 'As you treat me, so will I treat you.'

Reciprocity

"The German *Luftwaffe* has set the example in this direction, and the care with which the prisoners entrusted to it have been treated has been rewarded by similar treatment being given to German air crews—not many of them—who are in the hands of the enemies. Of this fact we have exact information. For example, we discovered once that for some reason smokes were being withheld from German fliers in French camps. Following this, French and English prisoners of war had their supplies of cigarettes stopped and were told why. They at once wrote home about it, and in three days German fliers in France and French fliers in Germany were smoking again.

"The German *Luftwaffe* has several of these camps. The one dealt with in this article lies at the foot of one of the prettiest mountains in Central Germany. The prisoners share a building but have their own separate bedrooms. Frenchmen and Englishmen have their own floors, but for meals they share a common dining room, in which they can sit as they like at separate tables. The food is the same as that of the Germans who keep guard over the prisoners.

Food from England

"The prisoners can, however, obtain from home the sort of food to which they are accustomed, via the Red Cross. The English in particular take great trouble over this, presumably because they fear that their relatives must be starving in 'blockaded' Germany, but above all probably because they want to impress us with the fact that they have plenty in England in spite of U-boats and air attacks.

"The prisoners are allowed to go for walks every day for several hours in the beautiful surroundings of the camp. These walks are quite optional and the guards are few—an officer and an interpreter. On these walks the French seem to set the pace. They want the exercise to offset the enforced 'room-squatting.' In this connection it might be mentioned that a sports ground is now being laid out.

"The prisoners receive from the *Luftwaffe* a certain amount of pay, corresponding to their rank. This is paid in special camp money. This arrangement conforms to international agreement, and is also used for German prisoners in enemy countries. A man drawn from the camp guard visits the nearest town in order to make purchases for the prisoners, and each time he carries a long list of articles wanted.

"The prisoners are allowed to spend their leisure hours, which means practically the whole day, almost as they wish. They can listen to the radio (only the German, of course), and they have a library in their own language which is provided by the Commandant of the camp. They read a great deal, some of them paint, others learn languages or undertake special studies, but, above all, they sleep. Taking it all round, the British and French fliers have all that they could reasonably ask.

Not Responsible

"The question might be asked how it is that these people, whose Governments have inscribed the destruction of Germany on their banners, are given such good treatment. The answer is that one cannot identify individual members of a Fighting Service, who have been taken prisoners as a result of fighting, with their Government and punish them for its acts. But, above all, it is, as already stated, a question of reciprocity. So long as German prisoners in France and England are not badly treated there is no occasion for a change in our arrangements. The relatives of German fliers who are prisoners of war in Britain and France can be satisfied that German 'fairness' (to use deliberately an English word) to the prisoners entrusted to us will ensure that also our fliers in England and France are treated as well as it is possible in captivity."

The article also points out that Poland is at long last brought together with her Allies, France and Great Britain, but that it took a prison camp to do it. It appears that a certain number of airmen of the Polish Air Force act as batmen to the French and British Air Force officers. The article does not mention—possibly because the writer was not aware of the fact, but more likely because it was thought good policy to disguise it—that hundreds of men and officers from the Polish Air Force are now in training here and in France preparatory to forming units in the Allied Air Forces.

SOME SECRETS OUT

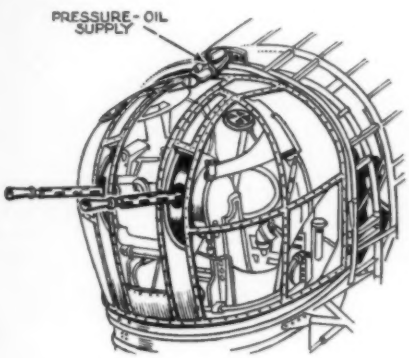
A German Report on Armament Found on Captured Allied Aircraft

A REPORT has been made by Dipl.-Ing. Joachim Beseler, of Berlin, on the armament installations found on examples of certain types of Allied aircraft which have fallen into German hands. The machines concerned are versions of the Armstrong Whitworth Whitley, Bristol Blenheim, Vickers Wellington, Amiot 143, LeO 45, Potez 63, Morane 406 and Curtiss H 75-Cl.

The author points out that the American-built Lockheed Hudson has English armament, whereas France's Curtiss fighter is equipped not with French but with Belgian-built machine guns of the F.N.-1938 type (Browning).

The version of the Whitley reported upon (one of the earlier series) has a total armament of four machine guns; one in each of the front and rear turrets (Vickers K), and two Brownings in a retractable and rotatable turret beneath the fuselage. The two last-named guns are operated simultaneously, being trained and fired by hydraulic means.

The rear turret is about 31½ in. in diameter and 33½ in. from the level of rotation to the top. The gunner sits in



The nose turret of the Vickers Wellington bomber housing twin Browning guns. The stern turret is of similar construction.

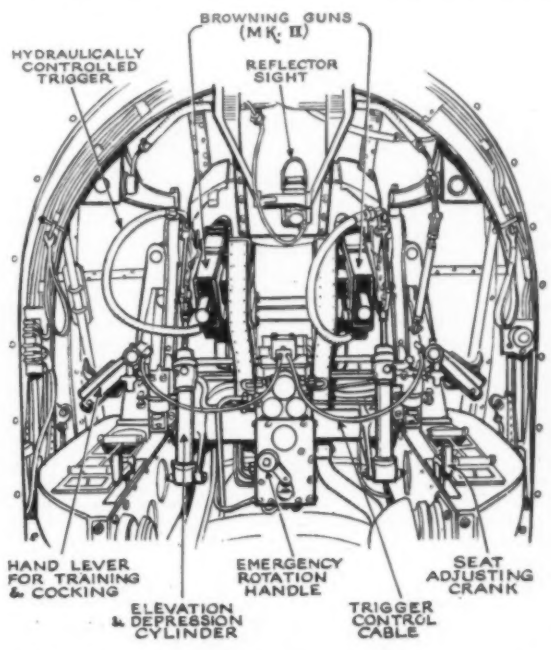
a cradle-like arrangement, elevation or depression being effected by lowering or raising the body with the seat. Traverse is given by turning the seat together with the whole upper part of the turret. The gun can be trained independently of the turret and ordinary front and rear sights are provided. It is pointed out that the angles of fire obtainable are dependent to a large extent on the size of the gunner. The range of vision from the turret is considered good, but it is said that sighting is somewhat hindered by the curvature of the transparent panels from which the cupola is constructed. The turret is accessible from the fuselage during flight, but access, particularly in thick flying clothing, is considered to be restricted. Pegs for seven ammunition drums (60 rounds each) were found in the turret, but it is pointed out that an unrestricted reserve of ammunition may be carried in the fuselage. The author states that the front turret seemed to be constructed in a similar fashion though exact statements were impossible due to the extensive damage.

The same applies to the lower turret which seemed to have an hydraulic operation for elevation, traverse and firing. The "steering" device is the same as that used on the Wellington. Deflection of the control lever is about 20 deg. for traverse and the same for elevation. The forefinger is used to depress the trigger, movement being transmitted by a Bowden cable to a hydraulic control box, and from this by means of pressure-oil types to the guns. No statement is made as to the speed of training or to the type and position of the sights.

All examples of the Bristol Blenheim which had been examined up to the time the article was written carried the same armament: one fixed gun in the port wing and a second in the dorsal turret. The wing gun is described as being supported relatively simply on two tubes between two struts; the gun is a Browning. A reflector sight is provided for the pilot. In the turret a Vickers K machine gun is placed on what is described as a "heavy pivot carriage"; the weight is about 66 lb., and the turret is of the full hydraulic type, being controlled by a simple handle. The piston of an oil-pressure cylinder, pivoted at its lower end, moves the gunner's seat sideways, the stroke being about 12 in. "In addition to this," it is stated, "a similar piston effects an additional stroke of about 30 deg. swinging angle." Elevation and depression (plus 70 deg.; minus 45 deg.) are effected by means of another hydraulically-operated piston, the gun and gunner's seat being connected by a parallelogram arrangement. A simple reflector sight is provided.

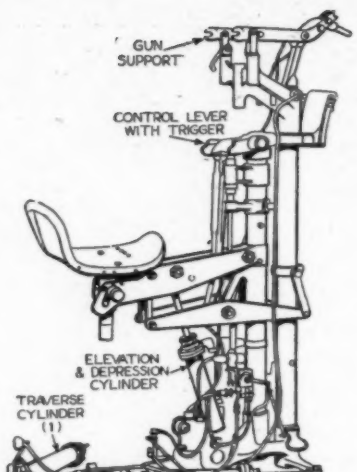
The armament of the Vickers Wellington is considered to vary, some machines having six Browning guns in three turrets (nose and stern and lower retractable), while others have the lower turret omitted. The nose and tail turrets are of the same type, the diameter of the ring being about 37in. and the height from the ring to the top of the cupola about 33½in. The gunner sits on a simple seat which is adjustable for body size and follows the rotation of the turret. Oil under pressure is fed to the turret by means of a rotatable connection at the top of the cupola. Control is completely hydraulic and is similar to that already described in the case of the Whitley. On one turret tested full traverse from left to right (190 deg.) took 8 sec. and operation over the full elevation-compression range (100 deg.) about 4 sec. Traverse is effected by a hydraulic motor operating a pinion which acts on the tooth rim of the main ring. There are two oil cylinders. Auxiliary manual operation is provided for traverse, there being a hand crank which can be engaged with the pinion. Sighting conditions are not considered very good, and it is stated that in special flying clothes the space is restricted. Each gun is provided with 1,000 rounds of ammunition in a belt of the disintegrating type, and each turret has 1,000 rounds in reserve.

The French machine guns examined were exclusively of



The interior of the Wellington nose turret with some of the features annotated.

The mechanism inside the power-driven turret on the Bristol Blenheim.



the Aviation 34 type, and these, together with the Hispano-Suiza shell-guns, are stated to have made "a far more modern impression than the English equipment." Fairly detailed description is given on the armament installations on the Amiot 143, but as this machine is obsolescent it is not considered worth transcribing. The LeO 45 is stated to carry a 20-mm. shell-gun on top of the fuselage in addition to an 8-mm. machine gun. The free guns on the various versions of Potez 63 are carried on what is termed a "light pivot carriage." Operations of the fixed machine and shell-guns is by compressed air.

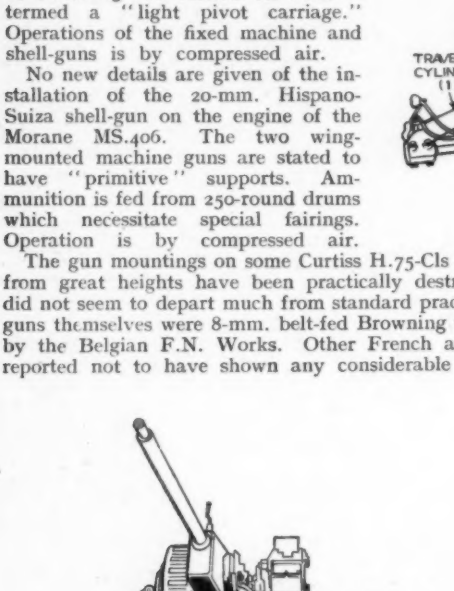
No new details are given of the installation of the 20-mm. Hispano-Suiza shell-gun on the engine of the Morane MS.406. The two wing-mounted machine guns are stated to have "primitive" supports. Ammunition is fed from 250-round drums which necessitate special fairings. Operation is by compressed air.

The gun mountings on some Curtiss H.75-Cls shot down from great heights have been practically destroyed, but did not seem to depart much from standard practice. The guns themselves were 8-mm. belt-fed Browning type made by the Belgian F.N. Works. Other French aircraft are reported not to have shown any considerable novelties, though it is mentioned that the Mureaux 115 observation machine has an Aviation 34 machine gun firing through the airscrew hub and not a shell-gun. The rifle-bore Browning guns found in British aircraft were of the Mark II pattern. It was found that Browning guns of English, Belgian and Polish manufacture were of very similar construction.

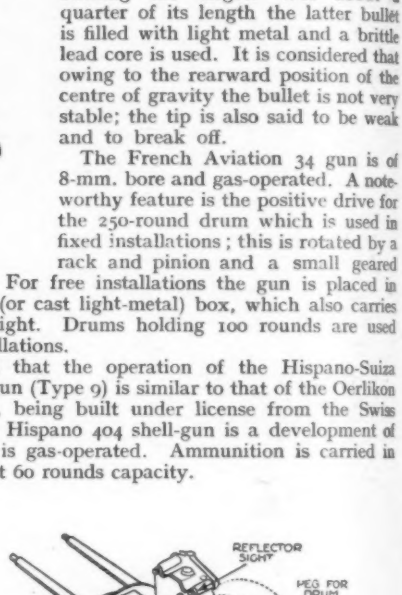
With the English guns four types of ammunition are said to have been found: Steel-cored pointed type; flame tracer; incendiary, filled with phosphorus; and disintegrating type which breaks up into small pieces on striking the target. For about a quarter of its length the latter bullet is filled with light metal and a brittle lead core is used. It is considered that owing to the rearward position of the centre of gravity the bullet is not very stable; the tip is also said to be weak and to break off.

The French Aviation 34 gun is of 8-mm. bore and gas-operated. A noteworthy feature is the positive drive for the 250-round drum which is used in fixed installations; this is rotated by a rack and pinion and a small geared countershaft. For free installations the gun is placed in a sheet-metal (or cast light-metal) box, which also carries the reflector sight. Drums holding 100 rounds are used for such installations.

It is stated that the operation of the Hispano-Suiza 20-mm. shell-gun (Type 9) is similar to that of the Oerlikon "FF" model, being built under license from the Swiss concern. The Hispano 404 shell-gun is a development of the type, but is gas-operated. Ammunition is carried in drums of about 60 rounds capacity.



On the left is the mounting of an Aviation 34 gun of 8 mm. bore on an Amiot 143 brought down behind the German lines.



In one installation on the Amiot 143 there is a twin combination of Aviation 34 machine guns as shown on the right.

Aeronautics in German Schools

THE American commercial attaché in Berlin reports that aeronautical instruction will form a part of the curriculum of all German schools, as this has been decreed jointly by the Ministers of Aviation and Education. The purpose is to ensure that there will be the largest possible number of suitable trainees for entering aviation.

Lecturer as Test Pilot

THE appointment of Albert C. Reed as chief test pilot of Boeing Aircraft Company has been announced. Reed joined the Boeing staff in July, 1939, as test pilot, having previously been with the Douglas Aircraft Company for over three years. He served as co-pilot on DC4 tests and was in charge of the flight planning and testing technique.

A graduate of the California Institute of Technology, holding a B.Sc. degree, he entered the Air Corps Flying School in 1930. Upon completion of his training with the Army he returned to California Institute of Technology in 1932 for post-graduate work. He taught aerodynamics in the University of Minnesota in 1934. Reed has been referred to as "an outstanding example of the modern type of test pilot who is primarily an aerodynamicist and approaches test piloting with a thorough knowledge of airplane fundamentals."

Lockheed Commercial Survey

A QUESTIONNAIRE circulated among 1,000 pilots and 464 maintenance heads by the market research section of the Lockheed Aircraft Corporation shows that 82 per cent. of airline pilots prefer two-engined aircraft in the 12- to 20-passenger class. For bigger than 25 passengers, four-engined were voted for by 88 per cent. Three-engined aircraft had no following at all.

Though only 23 per cent. had operated aeroplanes with nosewheel undercarriages, 89 per cent. expressed a preference for this type of landing gear, 60 per cent. asking for a steerable nosewheel. Brake toe pedals were voted for by 93 per cent. Almost all desired radio controls within reach of both pilot and co-pilot.

HERE and THERE

Controller of Light Alloys

THE Air Ministry announces that, in order to strengthen the arrangements for the control of the light alloy materials required for the manufacture of aircraft, the Rt. Hon. Sir Samuel Hoare, the Secretary of State for Air, has appointed Brigadier-General H. A. Jones to be Controller of Light Alloys. Concurrently with this appointment, powers are being taken by the Secretary of State under the Defence Regulations to control the fabrication and distribution of light alloys and to take such other steps as may be necessary to make the control effective.

Brigadier-General Jones will take up his duties, which will be whole time, at an early date. He will have the assistance of an Advisory Committee which will include Mr. H. W. Clarke, Mr. W. C. Devereux, Mr. F. S. Mitman and Mr. P. Pritchard, who have up to the present acted as voluntary part-time controllers of light alloys. The headquarters of the new control will be located in the Midlands.

Brigadier-General Jones served with distinction on the staffs of Field Marshal Lord Haig and Sir William Robertson during the Great War and occupied the post of Deputy Quartermaster-General (Home Forces). After the war he joined the Imperial Tobacco Company and is now a director. He has thus had considerable experience of the problems of large-scale organisation.

He served last year as chairman of a committee appointed by the Secretary of State to review the system of Royal Air Force administration.

Canadian News Items

THE Royal Canadian Air Force for the first time went on this year's Atlantic ice patrol, and carried observers from the ice patrol boats of the Department of Transport. Due to a "radio blackout" for shipping on the Atlantic coast the ice control could not be made by boat in the usual manner. Aircraft began patrolling the coast on March 15, making daily flights and reporting on reaching shore to the special ice information office established at Halifax, from where radio reports were sent out to shipping. The "radio blackout" is in force to keep positions of ships from the enemy.

Official civil aviation figures released by the Department of Transport, Ottawa, for the calendar year 1939, show that there were 795 private pilot licences in force at December 31, 166 commercial, 191 limited commercial, 147 transport pilot, 722 air engineer licences, and 7 airport traffic control officers were licensed. Canada had at the end of the year 76 licensed private aircraft, 412 commercial aircraft and 116 licensed airports.

The 22 light aeroplane clubs, operated under part Government subsidy, had a 1939 membership of 2,884, had 102 aircraft in use, gave instruction to 796 members, flew the record total of 31,210 hours, and received Government grants for 190 private pilots and 42 commercial pilots trained.

World's Largest Bomber

SINCE publishing the particulars of the giant Douglas bomber, the B19, which appeared on p. 391 of the April 25 issue, additional information shows that the power of the aeroplane, which was reported as 6,000 h.p., considerably exceeds this figure. The four engines are now stated to be 18 cylinder Wright Duplex Cyclones, which engine has lately been approved with a rating of 1,700 h.p. at 2,300 r.p.m. at 6,500ft. pressure altitude. Its rating for take-off purposes is believed to be near 2,000 h.p., which gives a take-off power loading of 19.6 lb /h.p.

The Duplex Cyclones are mounted by the new "dynamic suspension" attached to the cylinder heads, which was described on page 286d of *Flight* of March 28. The size of the nacelle dwarfs this big engine and it appears likely that more powerful engines will be installed when these are available. A large aperture in the bottom of the nacelle may be both for the discharge of cooling air and a means of entry for maintenance purposes on the ground.

Interlocking Directorates

THE Civil Aeronautics Authority has given a decision on the case of LaMotte T. Cohu, who held three directorates on the boards of Transcontinental and Western Air, Northrop Aircraft, and an aviation finance group known as Air Investors, Inc. Under the Civil Aeronautics Act, this is subject to scrutiny as "the public interest may be adversely affected by the holding of such interlocking positions," in this case, in an airline, an aircraft manufacturing company and an investment firm. The Authority, however, allowed the interlock between T.W.A. and Northrop because the latter was not at present making any air transport craft. The other relationship, between T.W.A. and Air Investors, was disapproved on the grounds that it "allowed the existence of a mechanism which might permit disclosure of confidential information to the managers of the investment firm . . . which may result in benefit to the investment firm and in detriment to the air carrier."

It is interlocking relationships such as these—not prevented by legislation in this country—which were pointed out to be exceedingly dangerous to the future of air transport by "McAnguish" in his article, "Exit Civil Aviation?" in our issues of March 21 and April 4.

POLAND IN THE AIR AGAIN. Large numbers of the Polish Air Force are now being trained in this country and will form self-contained units. Here the Polish standard is being hoisted with the ensign of the R.A.F.

Penang Flying Club

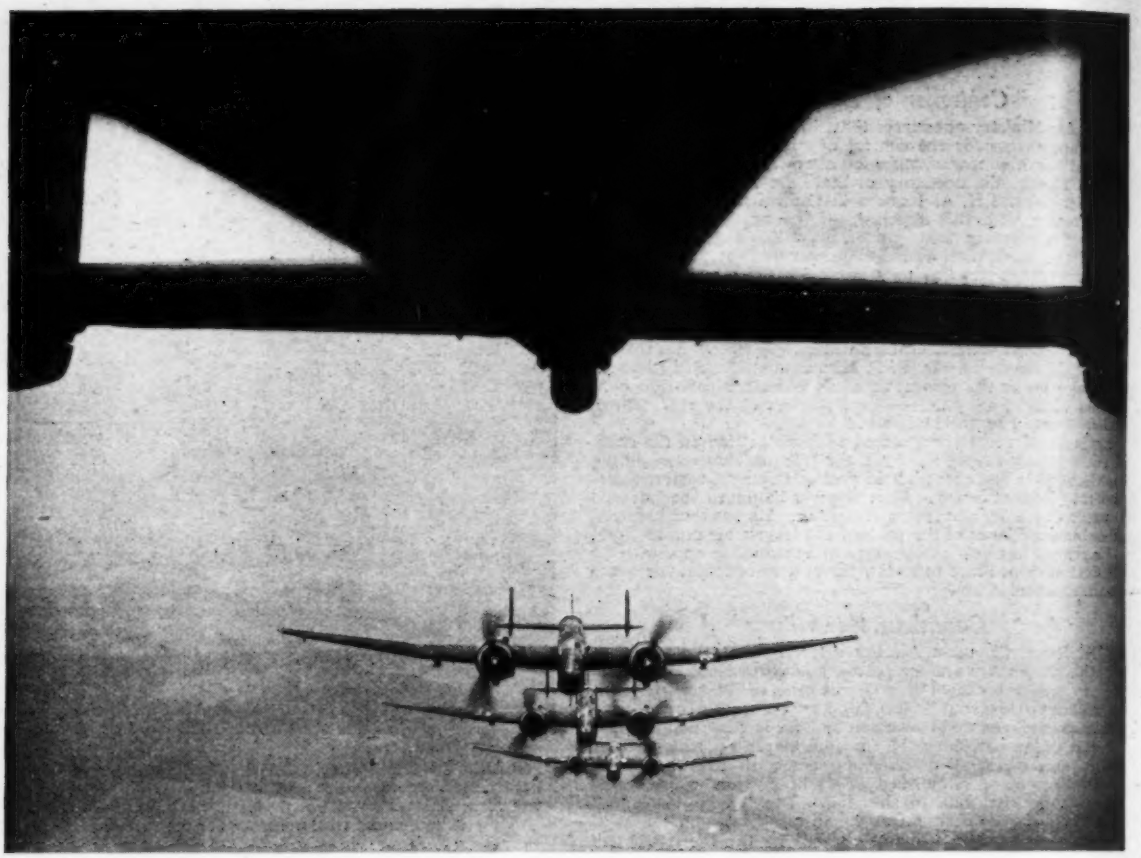
IN contrast to the state of suspended animation in which the United Kingdom flying clubs find themselves due to the war, the Penang Club is flying actively. Thirteen hundred hours were logged for 1939 using five aircraft, and the club claims the remarkable record of no engine failures, not only in 1939 but since its inauguration. Its present equipment consists of six Gipsy Majors.

The financial side, usually a difficulty with clubs, is not so happy as expenditure exceeds income for the year by $4,857, amounting to 54 per cent. of expenditure, although a grant of $21,200 was received from the Government. The average charge for flying works out at just over $7, about 16s. per hour. Total membership is 200, of whom 100 are flying members.

The cost per flying hour is $30, which is £3 7s. 6d., with the Straits dollar at 2s. 3d. But it is noted that depreciation on five machines for the year is only charged up at $100, a quite inadequate figure. Analysing the total cost, the items are: petrol and oil, 16.9 per cent.; instructional staff, 16.9; ground maintenance staff, 36.2; maintenance material and spares, 8.2; depreciation of aircraft, 0.2; insurance, 1.5; clubhouse and administration, 17.6; miscellaneous, 2.5 per cent.

Science Museum Exhibition

THE exhibition of engines and model aircraft at the Science Museum, South Kensington, has been augmented by the loan of a Hawker Hurricane fighter from the Air Ministry. The aeroplane is one which has been in active service with the Fighter Command.



"Line astern" by Hampdens as seen from the lower gun position on a machine of the same type.

THE "O/400" TRADITION

With the Hampden Bombers

By H. F. KING

(Illustrated with "Flight" Photographs)

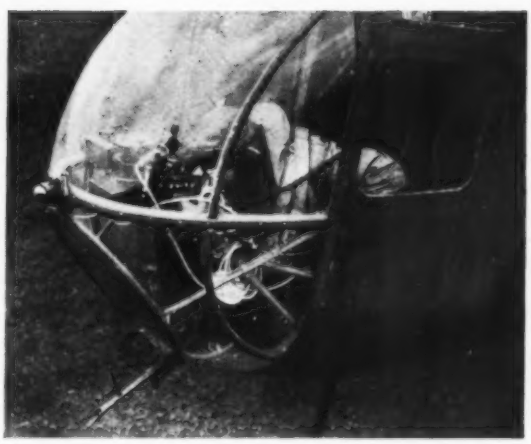
THE official history of Great War No. 1 records numerous night attacks on enemy centres by Handley Page O/400 bombers. A typical mention reads "Two Handley Pages of No. 215 Squadron left their aerodrome at 8 p.m. on the 25th August on the first attempt to be made by the Squadron to attack the Badische works. One pilot approached the target from the north-west, through a searchlight barrage and under gun-fire, and, gliding down from 5,000ft., made his attack from a height of 200ft. The lights in the works had been put out, but the searchlights, in their attempts to find the bomber, were trained almost horizontally, and they clearly illuminated the works for the bombing crew. Many of the bombs (sixteen 112-lb. and ten 25-lb.) were seen to explode among the buildings, and when they had been released the pilot continued to fly low for some minutes while the machine guns from the Handley Page traversed the area. The second pilot came in close behind the first and made a somewhat similar attack from 500ft."

Such exploits by the O/400s (the war finished too soon for the later and larger V/1500s to prove their real worth) resulted in the popular association of the name Handley Page with big bombers. To-day Handley Page bombers are again flying over Germany but they are far removed from the awkward-looking O/400s; they are the slim Hampden monoplanes of a Bomber Group in the north country. The following figures for the Hampden and O/400 are not without interest:—

	O/400	Hampden (in overload condition)
Span	100 ft.	69 ft. 2 in.
Wing loading	8.5 lb.	31.43 lb.
All-up weight ..	14,000 lb.	21,000 lb.
Disposable load ..	5,800 lb.	9,220 lb.
Top speed	97 m.p.h.	265 m.p.h.
Range at economical speed	720 miles	870 miles
Armament	3 machine guns	6 machine guns

Until the big raid on Sylt on the night of March 19 few major operations had fallen to the lot of the Hampdens, but on that occasion, in conjunction with other aircraft of the Bomber Command, they gave the German base a hammering which

Since the beginning of the war the armament of the Hampden has been revised. It will be seen that there are twin Vickers K guns on upper and lower rear mountings and a movable gun firing downwards through the nose. A fixed Browning is provided for the pilot.



must still throb on the massive body of the *Luftwaffe*.

It was not Sylt, however, of which our officer-guide talked as he drove us out to a Hampden aerodrome; it was the more recent sinking of a German cruiser at Bergen by a Hampden piloted by a Flying Officer who, in the face of intense anti-aircraft fire enabled his navigator and bomb-aimer, a Pilot Officer, to secure a direct hit. This dashing exploit had temporarily overshadowed the magnificent work of the Hampdens on "Security Patrol" and their nocturnal leaflet-dropping excursions far into Germany.

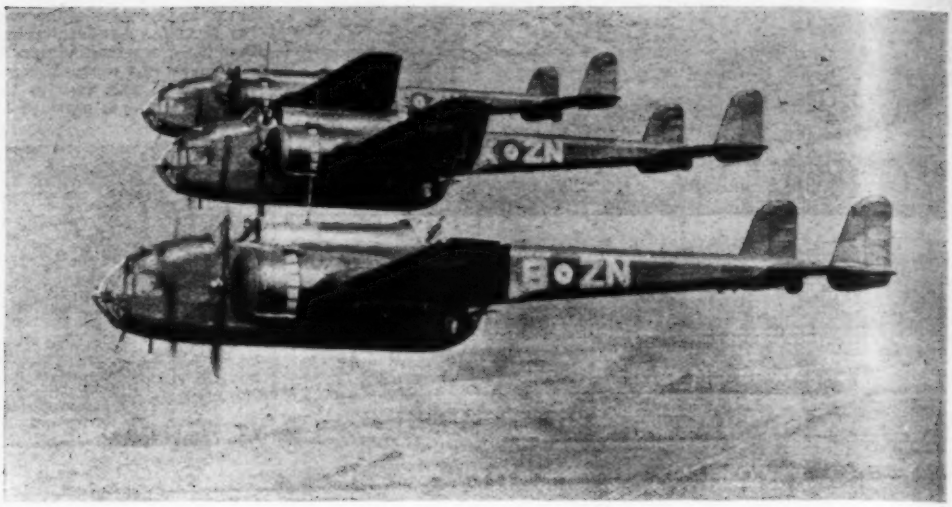
At the aerodrome we were received by the Group Captain who, before the war, was associated with the construction of the Hampdens. The Group Captain explained that the squadron we were to visit is a sort of university for bomber crews. The pilots are not drafted direct from an F.T.S., where they have their initial bombing instruction, but first attend a "high school" in another part of the country.

Details of the instructional system at the "university" and of much of the newly installed equipment are confidential, but the standard of instruction is such that if a first-line squadron sustains casualties the gaps can be instantly filled by men who are classed "operationally fit."

The squadron is organised in three flights, two of which are composed of personnel who are ready for immediate posting to an operational unit while the third is a sort of reservoir. Pilots who are now being received joined the R.A.F. since the beginning of the war.

The training necessary to keep the crews in this state of readiness covers high, medium and low bombing; gunnery (including formation fire control); practice in evasive action, which is calculated to muddle the Messerschmitts; take-offs, climbs and landings with full war load by day and night; high-altitude flying up to 25,000ft.; and long-distance flights of five

A pair of 500-lb. bombs being loaded, complete with carrier, into a Hampden.



Its ease of control makes the Hampden a pleasant machine to fly in formation. Here is a compact stepped-up echelon.

Dinghy drill. On the left members of the crew are abandoning a Hampden and the dinghy is seen inflating. Below they are all aboard. The cylinder of CO_2 can be seen on the side of the dinghy.

hours or more duration. Bombing-up and rearming are also practised.

Other items demanding constant rehearsal are the abandoning of an aircraft with parachute and dinghy. For the former practice a large, deep, straw-filled mattress is placed by a stationary aircraft. On the word of command the pilot slides back his cockpit hood, climbs out on to wing and takes a header on to the mattress. Meanwhile the rear gunners tumble out of the door in the lower position and the bomb-aimer makes his exit head first through a door in the bottom of the fuselage. He would probably break his neck were he to leave feet first while in the air. Continuous practice has enabled the crews to be clear of the machine in nine seconds. The previous record was fourteen seconds.

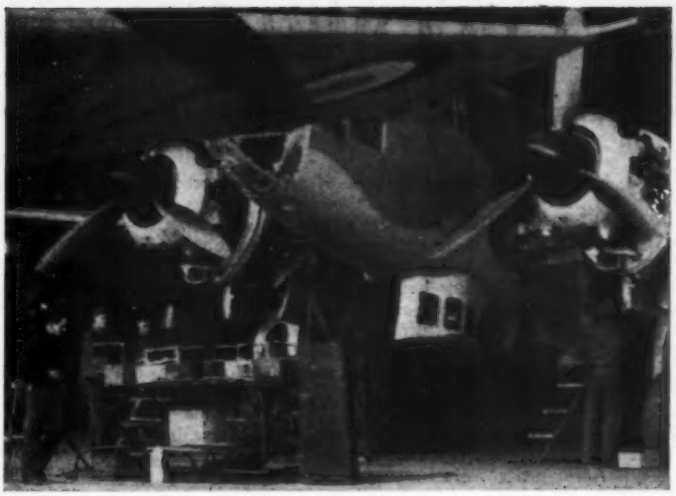
In dinghy drill the packed dinghy is thrown on to the wing and the crew leaves through the top of the fuselage. Pulling a cord causes the dinghy to inflate to the full extent of its triangular shape and the crew go aboard. Practice is sometimes given in the local swimming bath. Life-saving jackets, of course, are items of standard equipment.

A number of improvements have been made to the standard Hampden since the beginning of the war, notably in the arma-

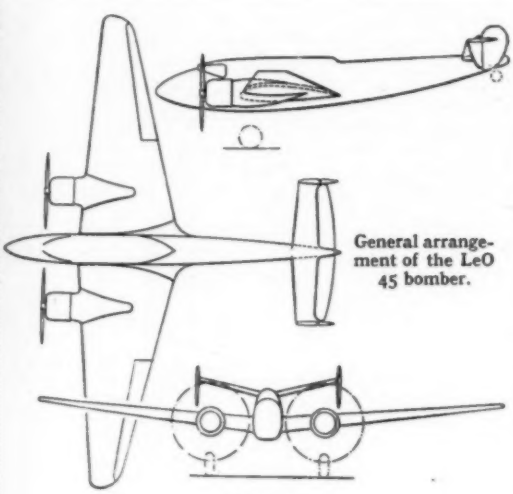
The Wing Commander, in the presence of the Group Captain, "briefs" crews detailed for an exercise. An officer of the Royal Australian Air Force is in the centre of the group.

It is believed that all the LeO 45s now being delivered are fitted with Hispano-Suiza 14 AA 14-cylinder two-row radials, which give about 1,080 h.p. at 13,100ft. This type of engine has a capacity of 45.24 litres and is just over 50in. in diameter. In the Mercier cowlings standardised the cooling air is admitted behind the airscrews through an adjustable entry so that the flow over the cylinders can be controlled. Tests are reported to have shown that the cowling is most effective when the airflow over the cylinders has a velocity 75 per cent. of that of the aircraft. A patented system of deflectors ensures that each cylinder receives an equal amount of air and that the maximum cooling effect is directed over the barrels. This air is not heated by more than 10 deg. and is then deflected forwards over the cylinder heads finally to be ejected into the airstream in front of the cylinders.

Alternative power units would be Gnôme-Rhône 14Ns, which have an output approximating to that of the Hispano radials. There have been mentions of a LeO 45 powered with two Bristol Hercules 14-cylinder two-row sleeve-valve radials. The moderately supercharged Hercules I was homologated at Chalais-Meudon over a year ago, and mention was made in *Les Ailes* at that time of the Hercules IV which, operating on fuel of 100 octane number, developed 1,570 h.p. for take-off, 1,420 h.p. at 4,920ft., and 1,290 h.p. at 14,760ft.



Behind the retractable under turret in this view can be seen the fuselage bomb doors. It will be gathered that the "45" is a comparatively large aircraft.



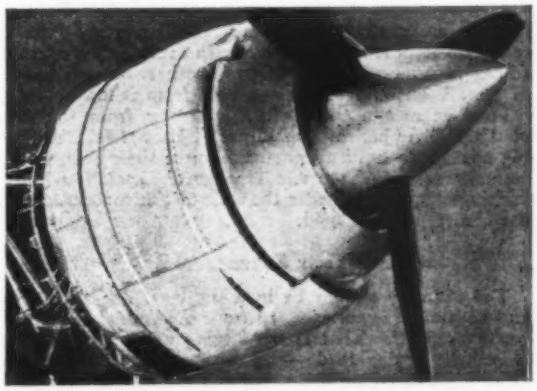
General arrangement of the LeO 45 bomber.

LeO 45

Two Hispano Suiza 14 AA Engines

DIMENSIONS	
Span	73ft. 9in.
Span (wings detached)	5ft. 3in.
Length	55ft. 2in.
Height on ground	14ft. 9in.
Height in flying position	18ft. 8in.
Wing area	667.36 sq. ft.
WEIGHTS AND LOADINGS	
Airframe	8,157 lb.
Engines	4,740 lb.
Tanks	420 lb.
Fixed equipment	728 lb.
Weight empty	14,045 lb.
Normal loaded weight	23,480 lb.
All up weight in overload condition	26,455 lb.
Weight of crew	780 lb.
Movable equipment	1,630 to 2,315 lb.
Fuel	2,780 to 5,290 lb.
Useful load	1,100 to 4,410 lb.
Wing loading	35.2 lb./sq. ft.
Power loading	10.36 lb./h.p.
PERFORMANCE	
Rated altitude	14,700ft.
Max. speed at 16,400ft.	310 m.p.h.
Max. speed at sea-level	250 m.p.h.
Min. flying speed	80 m.p.h.
Landing speed	60 m.p.h.
Climb to 13,000ft.	10 min.
Range in still air	745 to 1,430 miles
Absolute ceiling	27,880ft.
Service ceiling	26,740ft.
Diving speed	388 m.p.h.

Crew stations are heated by hot air, having individual controls, and 8,000 litres of oxygen are provided. There is provision for an automatic 30-mm. camera and a hand camera for reconnaissance work. The equipment also includes a Jaeger-Smith automatic pilot.



A Mercier cowling as used on the Hispano-Suiza 14 AA engines of the LeO 45. A notable point is that the cooling air enters behind the airscrew.

CO-OPERATION in U.S.A.

Exchange of Data Between Airlines : Government and Industry Collaborate

ONE very noticeable feature of air transport in the United States is the co-operation which exists between airlines even when they are in competition. Up till lately the greatest degree of co-operation occurred in the field of safety, but because of the beneficial results the co-operation is now being extended to other matters.

"It pays to fly," the joint advertising campaign; the recently-signed airline arbitration agreement; the air traffic conference similar to the successful trans-oceanic steamship conferences—these are all examples of co-operation. All the airlines and aircraft manufacturers, aided by legislation enabling Government authorities to function in an efficient manner, have done their part. Here is what Colonel Gorrell said in an address not long ago about the Civil Aeronautics Act:

"It would appear that the rôle of Government must be restricted to the most vital things, and that industry itself must be enabled to shoulder much of the burden of providing the regulation which it needs. How this can best be accomplished for industry generally it is difficult to say. One suspects that there is no ready formula which can be applied to every business. But Congress has recently taken a step designed to meet the need of one important industry."

Air Transport Association

The value of this Act so far as safety is concerned is that the administration of the subject may be, and in practice is, conducted by the Administrator of the Civil Aeronautics Authority and not by the five-man board of the Authority, although the five men do approve safety regulations and their amendments. The Administrator also directs the construction, operation and maintenance of air navigational aids and makes recommendations to the Government for providing weather service "necessary for the safe and efficient movement of aircraft in commerce."

The accomplishment of this important administrative function has had, and will continue to have, a beneficial effect on safety, not only for the air carriers, but for the Army, Navy, and thousands of private and non-scheduled commercial operators. In addition to the Authority and the Administrator, the Act has set up an Air Safety Board to investigate and report on accidents and to make such studies about air safety as the Authority may request.

Painstaking, scientific and co-ordinated effort is responsible for the present airline safety record. The effort has been led by the airlines themselves. Frequent conferences are held to discuss all phases of safety, including operation, maintenance, overhaul, flight technique, and personnel problems. Between meetings, memoranda on these subjects are exchanged. Every operator is put "on the spot" to improve, to keep up with every other operator. It has become embarrassing to do otherwise, particularly as there is encouragement and help from fellow-operators.

Four years ago the airlines withdrew from the Aeronautical Chamber of Commerce. They felt they were big enough to have an organisation of their own, and on January 14, 1936, the Air Transport Association had its first meeting. It is under the ægis of this association that the conferences are held.

"Two Schroeders"

The industry should be in a position, due to intimate and continued experience, to work out most of the safety problems itself. That is what the air transport industry is actually trying to do—and with some success. It has an operations committee, of which the chairman is Major R. W. Schroeder, vice-president of United Air Lines, a safety-first man. He held the world's altitude record for some time, and was chief of airline inspection in the Bureau of Air Commerce for several years. His policy was: "Let the industry do the job itself. If it cannot do it, help it. If it will not, force it to do so by regulation." Schroeder seldom had to invoke the last-mentioned procedure. He was so good in his job and so thoroughly respected that an airline did what he suggested. At a conference in Washington someone mentioned the safety precautions of having two engines, two radios, and in some cases two tails. An insurance man replied that what aviation needed was "two Schroeders."

Three Forms of Training

In America it is fully realised that steps must be taken to prevent failure of the human element both in the air and on the ground. This is accomplished by continuous and systematic checking, inspecting and training. The operations committee has worked hard on the subject of training pilots and the elimination from flight duty of those who are unfit. In this work they have made the services of expert flight surgeons available to each of the airlines. Pilot training programmes, data on which are exchanged through the committee, have been put into effect by all airlines. Three methods of training are used: extension courses, with classroom work at times and places convenient for the pilots; actual flight training and checking by the chief pilots; and simulated instrument flying on Link trainers.

Written courses, combined with classroom work, include drilling in things to do and who does them, navigation and meteorology, and the most efficient throttle settings for power and economy. In these courses motion pictures are shown of aircraft in varying flight positions, with silk streamers on the wings to depict airflow and its effect on flight. This is an example of collaboration between industry and Government. An airline provided the aeroplane and crew, while the National Advisory Committee for Aeronautics supplied the apparatus and the research brains.

Many improvements in airliners have been made possible by the research work of this committee and by manufacturers of equipment. The Civil Aeronautics Authority has a planning and development section which has done some worth-while experimentation and testing. This division co-operated with manufacturers and airlines on the de-icing problem and is now working on the instrument landing system and on fire prevention.

Frequent Conferences

Planning and development work goes beyond determining accident causes to accident prevention. The engineering and maintenance committee of the Air Transport Association meets twice a year. Progress is so rapid in air transport that annual meetings are too far apart. The meetings are rotated among places where airlines have workshops, so the "host" airline can show methods and equipment, and agendas are made up of current problems. No more than two papers are read by experts, the rest of the three-day conference being devoted to exchanging experiences. The Army, Navy, Civil Aeronautics Authority, N.A.C.A. and Bureau of Standards all send their technical men to these discussions.

Probably no industry exchanges technical data to the extent that air transport does. Like the operations committee, the experts exchange notes between conferences. The Army and Navy are on the mailing list for these data, and reciprocate. A sub-committee of engineers has in its membership chief engineers of airlines, two of whom are well-known test pilots. By all these co-operative means is safety on the airlines being sought, and recent accident figures show how effective the efforts are.

THE "O/400" TRADITION (CONTINUED FROM PAGE 6)

guessed 250-260, expecting quite a mild zoom to follow. Certainly we were not counting on such a sharp tilting of the horizon and such rapid contraction of the aerodrome below our tail. Toward the end of the zoom we looked out at the automatic slats, half expecting them to open, but they stayed closed.

Back in one of the crew rooms where pilots and navigators are "briefed" the Group Captain pointed out that the Hampden is not only capable of delivering heavy punishment but can take it in large doses if the occasion arises. A number of these machines have glided down out of the North Sea mists bearing some bad scars which, on less sturdy machines, might have been fatal wounds. On one occasion when a Hampden formation encountered a bunch of Messerschmitts the Me's opened up with their shell-guns. One projectile entered the pilot's enclosure just behind his head and went out through the Perspex, leaving a hole the size of a teaplate. A second came in at a different angle with similar results. Point will be lent to this story if the pictures which show the over-all size of the enclosure are examined.

As we were taking leave of the Wing Commander he received a "met" report promising clouds at 800ft. by dark. So he made the evening exercise low-bombing practice.

A RUMANIAN RADIAL

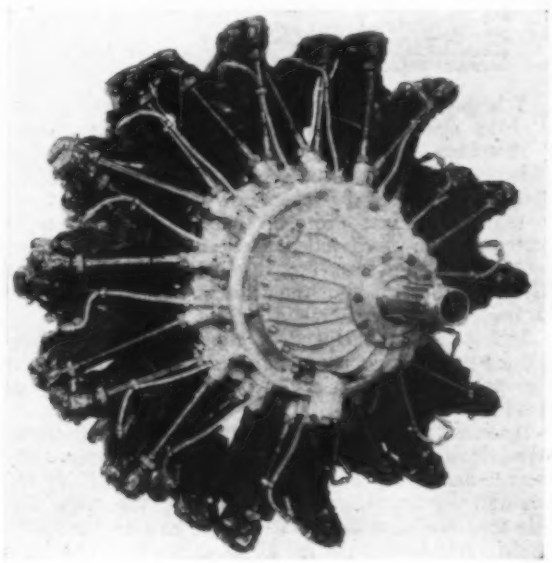
THE first 1,000 h.p. aero engine to be produced in Rumania, the I.A.R. 1,000-A, has just been announced. It is a 14-cylinder two-row radial air-cooled unit, and is available in two forms—supercharged to give its rated h.p. at 12,460 ft. or at 10,500 ft.

The crankcase consists of five main parts bolted together. The main casing, forged from light alloy, carries the cylinders, and has the front casing and manifold casing bolted to it, while, in turn, the reduction gear casing and rear cover are bolted to these. The seats for the crankshaft roller bearings are made from aluminium bronze pressed in hot and the crankshaft is made from forged Ni-Cr-Mo steel in three parts. A driving hub is situated at the rear of the crankshaft to operate the accessories mounted on the rear cover. Dogs are provided to engage with the I.A.R. (Eclipse licence) inertia starter, which may be operated either electrically or by hand.

The two main connecting rods are made in one piece from forged Cr-Ni-Mo steel, being of double T section tapered towards the little end. The secondary connecting rods are of the same section, but are not tapered. The forged light alloy pistons are of an improved type, having free movement for the gudgeon pins, which are held in place by two spring steel clips. The cylinders are made of special forged chrome alloy steel, and are screwed into the heated cylinder heads, which are made of light alloy. Each cylinder has two valves, one inlet and one exhaust, the exhaust valve being sodium cooled. The valves are connected to the cams by means of roller tappets, push rods and valve rockers fitted with needle rollers and oiled under pressure.

One automatic Zenith carburetter is mounted in front of the supercharger, which is of the centrifugal type. The fuel supply is controlled by two I.A.R. pumps on the rear cover. Ignition is provided by two Bosch magnetos revolving at $\frac{7}{8}$ engine speed. Two sparking plugs are provided for each cylinder.

The engine is lubricated under pressure by gear pumps, the main pump providing high-pressure lubrication of important points, such as connecting-rod bearings, tappet gear, cams, rocker gear, reducing gears and supercharger gears, while the other serves to circulate the oil through the radiator.



The 1,000 h.p. I.A.R.

The more important data concerning this engine are as follows: bore, 146 mm.; stroke, 165 mm.; capacity, 28.7 litres; compression ratio, 6 and 6.1; maximum take-off power for 3 min., 1,140 h.p.; normal take-off power, 1,005 h.p.; rated power, 1,020 h.p. at 10,500ft. and 12,500ft.; fuel consumption, 0.64 lb. per h.p./hr.; diameter of engine 49.88in.; length, without airscrew hub, 62.11in.; weight (in service condition), 1,466 lb.

The engine is said to be adaptable to series production and is at present in use on I.A.R.39 and I.A.R.80 aircraft.

Aer Lingus Traffic Increases

INCREASING tendency to travel by air between Eire and Great Britain is evident from the traffic returns of Aer Lingus, Teoranta (Irish Air Lines) since the inauguration of the Dublin-Liverpool service on October 23, 1939.

Aer Lingus are to be congratulated on the fact that for the period under review a total of 2,893 passengers were carried by the company on this service. War has, if anything, assisted to awaken people's minds to the vast possibilities of air travel in general and the company does not, of course, intend to allow the increased opportunities for extra business occasioned by the war to pass by its doors.

The demand for accommodation on the Dublin-Liverpool service has surpassed all expectations, and though extra machines have been pressed into service, and even duplicate services run, the demand keeps growing. The possibility of procuring larger aircraft has for some time been receiving the attention of the management and an announcement on this matter may be expected almost immediately.

Lockheed Lodestar Sales

THE recently announced order of 16 Lodestars for South African Airways is augmented by three other orders to raise the total to 25. Air France and Regie Air Afrique, operating from Marseilles down through the Belgian Congo to Madagascar, will take three each. D.E.T.A., which is a Portuguese-East Africa service from Lorenzo Marques to Port Amelia, has also ordered three.

AIR STRATEGY

"Current Strategic Use of the Air Arm" is the Title Given to This, the Sixth, of His Series of Articles

By CAPTAIN NORMAN MACMILLAN, M.C., A.F.C.

Marshal of the Royal Air Force, Lord Trenchard, advocates the use of Air Power to destroy enemy Air Power at source

IT is impossible to consider the strategic use that has been made of the whole British air arm without breaking it down into a number of sections, each of which is engaged in some specific employment. When that is done it becomes clear how comparatively small is the independent effort of the Royal Air Force at present. The word independent is here used in the sense in which it was first applied by Lord Curzon's Air Board in 1917, when the decision was taken to create an Independent Air Force in France.

And it is that independent effort which really constitutes the strategic use of the Air Arm qua Air Power and not qua an auxiliary weapon of either Navy or Army.

It seems that Admirals have more confidence in themselves than have Air Marshals. The Navy never hesitates to act alone, to take the initiative. The Navy did not wait for any other Service when it sailed full blast into the German units in Norway and covered itself with glory. But always the Air Force seems to shrink from leadership of that kind. It must always be tailing on to one of the older Services like a young brother who is sure to be ticked off by his elders if he assumes too many airs.

Frankly, the difference between the Navy's outlook and that of the Air Force in this respect is, and always has been, incomprehensible to me. When will the Air Force grow up? Perhaps this war will see it pass out of adolescence, to develop a more mature and less dominated outlook.

But it appears at the moment that there is no air plan; no attempt to devise a grand strategic employment of air power.

The Navy, on the other hand, has a plan; a plan which was prepared in accordance with the traditions of naval warfare to suit the conditions of to-day; it is the plan of blockade. It involves the destruction of enemy warships at every opportunity. It involves the prevention of supplies reaching the enemy by ships. It involves the maintenance of the Allies' supplies by ships. All the sea power of Britain is bent to that one end. Whatever use the Navy makes of aeroplanes must fit into that plan. Admirals see the aeroplane as a naval weapon, even when it is directed against their own ships.

The Army has a plan. The shaping of the grand strategy of that plan is in the hands of the Generalissimo of the Allied Forces. It involves the prevention of the invasion of France, and its long-term policy is the destruction of the military power of Germany, represented in the German Army. In this plan the aeroplane is envisaged as an Army weapon, gifted with eyes and with greater power of movement than terrestrial weapons, able to bomb military objectives and to spray them with machine-gun bullets.

By comparison with the plan of sea warfare and the plan of land warfare, what does the air strategist offer? His plan must be withheld until after the vivisection of the Air Arm to meet the demands of the plans of sea and land.

So, from the viewpoint of the air strategist, we must consider the Air Arm as a force divided into eight primary combatant sections. (There are other sections, but they are of less importance, and are included in one or other of the eight primary sections.) The primary sections are:—

(1) Home Defence Fighters in the United Kingdom.
(2) Fighters in France.
(3) Offensive Bombers in the United Kingdom.
(4) Offensive Bombers in France.
(5) Coastal Command Aircraft in the United Kingdom.
(6) Army Co-operation Aircraft in France.
(7) The Fleet Air Arm.
(8) All other R.A.F. Units Overseas.

All eight sections are employed in the general Allied scheme for carrying on the war as envisaged by the Supreme War Council and its advisers, the Service Chiefs. But does not the disposition of the eight primary sections of Britain's air power display the fact that air strategy has been relegated (as in the war of 1914-1918) to a place of third importance, and that even in this most modern of all wars the two older Services, whose traditions go back to the days of bows and arrows and battle-axes, still rule the political roost when it comes either to large-scale rearmament or war?

The "Senior Service"

But there is precedent for a change in this subservience of the Air Arm to the traditional arms of the Defence Services. For at one time the Navy was subservient to the Army. The original British Navy consisted of ships manned by unarmed sailors who carried soldiers to sea to fight with bows and arrows, spears, stones and javelins. Yet to-day the Navy is always spoken of as the Senior Service. That appellation can be justified only if one is prepared to start history at one arbitrary point, that is during the period of Spanish grandeur following the ocean voyages of the early explorers. If one turns back to the earlier wars in France, which was the Senior Service, the Navy or the Army? Which did the Black Prince lead?

So, if the Air Service really wants to forge ahead with the war on the basis of Air Power, it has a precedent to justify its demand for a bigger place in the grand strategy of the Allies Supreme War Council. If the Navy managed to oust the Army from first place, why

should the R.A.F. be content to play a Nero's fiddle?

Now, every time a sailor or a soldier hears this "heresy" uttered about the air, he instantly exclaims, "But the Air Force cannot win a war on its own."

The answer is, of course, that no one ever said it could, any more than can the Army or the Navy. Nelson did not defeat Napoleon single-handed, nor did Wellington. The winning of war needs every weapon. And if those weapons are sub-divided among three Services, then obviously each of these Services is needed in war. But what is not needed is rivalry between them for pride of place. Their relative importance must be decided by what they can do.

And, to be honest, I must say that I have never come across a highly placed Air Force officer who has the same guts as to the efficacy of his service as one finds among the sailors and soldiers. Why do they have these doubts? I believe it is because they still have the outlook of the soldier or the sailor, and in their innermost hearts regard the weapon in their hands as another shot in the locker of the older Services.

Air Power

Lord Trenchard, alone of all the senior officers of the R.A.F. past or present, propounded a doctrine of Air Power before the present war began. He did so in a speech made in the House of Lords, a speech which received all too little attention in most quarters.

Lord Trenchard's dictum was that Air Power should be employed to destroy the Air Power of the enemy at its source. This, of course, is a doctrine contrary to those of the older Services, in which ship fights ship and battalion fights battalion; in which land fortresses may be attacked, but dockyards and regimental depots are, by a kind of unwritten law, ruled out; in which advanced munition dumps under the control of the combatant forces are desirable targets, while the places where those munitions are made remain immaculate.

So far there has been no attempt in this war by either side to apply the doctrine propounded by Lord Trenchard. Action against the air power of the opposing forces has been limited in each case to air combats, static defence by gunfire, and in the case of the R.A.F. bombing attacks against a number of aerodromes occupied by the *Luftwaffe*. Germany certainly attacked the air power of Poland in conjunction with the advance of the German army. But that was almost like the use of a club against an unarmed man.

Germany's record, in the last war and in this war, shows that she does not scruple to employ any method which will assist her to victory. Why then has she avoided (up to the moment of writing) any retaliatory bombing of British aerodromes as a reprisal for the R.A.F. bombing of Sylt, and the aerodromes in Denmark and Norway? Can it be that she is hoping to make out a case for justifiable air action on a large scale later? Or is it that she fears the effect of larger-scale bombing of German aerodromes upon the *morale* of the German nation? Or is it that her Air Force never moves until her army moves?

Whatever the reason may be, one thing is certain, and that is that the R.A.F. must be ready to smash German air power at its source if ever the Germans attempt to wield air power against the Allies as they hurled it against Poland.

It is all very nice to sit tight and conduct our quarrel with the Germans in accordance with time-honoured methods while the Germans do the same. But should the Germans change their method the Allies must be ready to do likewise. Mr. Churchill has said we will.

So it is good to have the three Services knit together more closely under the Committee of Defence Ministers presided over by Mr. Winston Churchill. The First Lord of the Admiralty was, presumably, personally responsible for the initial use of air power to strangle enemy air power at the source (that was when the R.N.A.S. made their raid on Friedrichshafen, the home of the Zeppelin factory, on November 21, 1914) for the machines used were specially sent from England to Belfort for the purpose. In his present position Mr. Churchill has more say over the use that shall be made of the R.A.F. than he has had during the first seven months of the war. It might be that his fertile brain has evolved counter blows to any German attempt to hurl air power against the Allies. If he has, the measures will have to comprise air action *qua* air power applied to destroy enemy air power at source, and not the counter-naval and counter-military air action of the R.A.F. up to date.

Of the eight sections into which I have sub-divided the R.A.F. for consideration of the current strategic use of Britain's air power only two are available for the direct application of air power against the sources of the air power of the enemy. These are the offensive bombers stationed in the United Kingdom and in France. It is possible that the Fleet Air Arm might play a minor part in such a strategic use of air power, but it is not its primary rôle, and its diversion from its true functions would have to be most carefully considered in relation to the whole campaign.

Now clearly there is a limitation to the requirements of some of the sections into which I have divided the R.A.F. of to-day. It ought to be possible, for example, to determine with fairly reasonable accuracy the optimum strength at which the 1st, 2nd, 5th, 6th and 7th sections will have to be maintained. It ought also to be possible to ascertain the rate of wastage in material and personnel, and therefore to assess the facilities needed to maintain these sections at full strength.

The 8th section is less easy to estimate, for it is composed of a variety of units widely scattered, some of which must be regarded as permanent garrison units, while others are part of a separate expeditionary force for which a greater establishment may become necessary if the war area grows.

Thus it can be assumed that there are six sections of the combatant side of the R.A.F. which are required for specific duties, and whose demands upon the production, recruitment and training facilities of the country can be fixed within a reasonable margin.

Offensive Bombing

Into the remaining two sections—the Offensive Bombers in the United Kingdom and the Offensive Bombers in France—every additional resource of Britain's latent air power ought to be poured. And these two sections ought not to be regarded in the way they are regarded to-day, as two separate entities, but as one; and, moreover, to them should be added the equivalent section of the French air force. This, then, would make the Allies Independent Air Force, and the instrument for the application of Air Power for the destruction of the enemy air power at its source. Its strategic operation as a whole force would make it far more difficult to counter-attack. Its employment should be independent of the operations of sea and land war, for it should be kept intact, so that it can be applied to the maximum advantage at the right moment, just as the ground forces in France are being kept intact to-day. For that purpose, some redistribution of the present war organisation of the R.A.F. will soon be required.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

ARMY CO-OPERATION IN NORWAY

Using the Roads

I HAVE read with interest the article by Capt. Macmillan concerning the difficulties of army co-operation work in Norway. He concludes that it is not possible to base aircraft of the Lysander type in Norway itself.

Now, for a great many years it has been stressed that the Lysander could land on, or take off from, a football pitch. That statement has appeared in *Flight*, as well as other aeronautical publications, time after time. If it is true, then I state most emphatically that Lysanders could be operated from local bases in *any part* of Norway, from within a dozen miles of any spot that Capt. Macmillan might care to pinpoint on a map. His article, had it been written about fighters or heavy bombers, would have been far more convincing.

There is, of course, a partial solution even to the use of fighters in local bases, other than frozen lakes. That is, fly them on and off the roads, which would, in effect, be somewhat narrow runways. I am fully aware of the obvious objections, such as disorganisation of traffic, but as I have followed the campaign in Norway, I gather that the whole success, or failure, of the Allied forces has hinged upon the need for first-line fighter aircraft to have been in action from the word "Go." Norwegian roads between main towns are good, and except where they pass through forests are free from side obstructions like hedges and brick walls. Aircraft operating in such a manner would run the usual hazards of war, but I contend that it would have been practical. Ground transport would have had to wait, and night flying would have been washed out, but it would have helped.

As things have panned out, there seems to have been no very serious effort made either to use Lysanders, which have been designed specifically for use in difficult tight fields (and Norway does not consist of nothing else but mountains), or to improvise with such facilities as were available in the shape of roads.

If the R.A.F. had to develop types of aircraft for every *possible* terrain, there would be no end to the new types that would appear in droves. As it is, types exist that can be adapted to every *probable* scene of operations, such as Norway, and if they are not used there, I would say that it was because of the Higher Command showing a lack of initiative rather than of any geographical obstacle. When the enemy forces the war into a new theatre it is up to us, the Allies, to *overcome* difficulties, not just to sit back and say that nothing could be done.

JOHN V. HEWES.

Ashtead.

FUTURE AERO ENGINES

What is the Maximum Power?

IN your issue of April 25, I noted with much interest the details and illustrations of the Douglas B 19 bomber. The military value of this machine may be very small, but its technical value and interest is of overwhelming importance.

The engines specified for this plane are Wright "Duplex" Cyclones of 2,000 b.h.p., driving 16ft. Hamilton airscrews. It would appear that six of these engines are included, not four. Total power output is 12,000 b.h.p. for take-off, and the power loading 13lb./b.h.p.; even this figure is higher than that of the Ensign. However, it is by no means unreasonable to suppose that the power of the "Duplex" will increase from 2,000 b.h.p. to 2,200 b.h.p., just as the Cyclone 14 has been rerated at 1,700 b.h.p. for the new CW-20 transport.

One of the Sunday papers recently informed its unfortunate readers that the Douglas B 19 could carry a 30-ton load of bombs from America to Japan and return without stopping to refuel. A technical expert has stated, on the other hand, that a machine of this size could not carry any bomb load for a range of only 1,600 miles.

The latter statement is based on the assumption that the wing structure weight varies directly as the cube of the span if the wing loading remains constant. The weight of the wing can, of course, be reduced by increasing the loading, but the wing loading of the B 19 is obviously low, about 30lb./sq. ft. If we compare a span of 210ft. with one of 70ft., it will be clear for all to see that the bigger one must weigh more per unit area.

In the figures that I give below, it is interesting to note how the wing loadings of Short flying-boats have increased, the wing of the projected 163,000 lb. being much smaller than that of the lighter B 19.

	C-class boat	G-class boat	Projected boat.
Wing area ..	1,500 sq. ft.	2,160 sq. ft.	3,380 sq. ft.
Wing span ..	114 ft.	134 ft.	169 ft. approx.
Wing loading	27 lb./ sq. ft.	34 lb./sq. ft.	48 lb./sq. ft.
Power plant	920×4	1,380×4	2,100×6
	3,680 b.h.p.	5,520 b.h.p.	12,600 b.h.p.
Power loading	11 lb./b.h.p.	13.3 lb./b.h.p.	12.9 lb./b.h.p.
Take-off time	24 sec.	30 sec.	—
Cruising speed	164 m.p.h.	180 m.p.h.	237 m.p.h.

Using six 2,100 b.h.p. engines produces certain disadvantages that are bound to affect performance adversely by comparison with four engines of 3,150 b.h.p. Presuming that the former engines drive 16ft. 3in. airscrews, 63½ per cent. of the wing length will be immediately behind the airscrew discs, resulting in a turbulent flow over almost the entire surface; to this, we must also add the greater installation drag.

Six or Four?

Although most of the very large aircraft that have been projected specify six or more engines, I am of the opinion that this is purely a passing phase. The Queen Elizabeth is powered by four engines of a combined output of something like ½ million s.h.p., the giant flying-boat of the future may well mount four engines totalling 25,000 b.h.p.

Progress in the direction of very high power in individual engines seems to be governed almost entirely by the limitations imposed on the designer by the airscrew manufacturer. It does seem now, however, that the airscrew designer will largely overcome the weight problem in the near future with hollow blades of magnesium allloy and by using four blades instead of three.

What is the largest possible individual aero-engine?

By individual, I mean a single crankshaft engine, as opposed to those having two or more crankshafts. The largest practicable unit is almost certainly the 42-cylinder, liquid-cooled, multi-bank with seven banks of six cylinders. The 54-cylinder multi-bank is not a practical proposition, mainly because of the very restricted space between each bank.

Both the Pratt and Whitney Co. and the Wright Aeronautical Corporation have been engaged in the design and evolution of new engines in the 4,000 b.h.p. class for some time past. Both are liquid-cooled jobs. The former being of H type, probably with four banks of eight cylinders, the latter is a 42-cylinder multi-bank, also liquid-cooled.

42 Cylinders

I have worked out a few figures for a 42-cylinder engine of the same bore and stroke dimensions as the 9-cylinder Wright G-200. Operating on fuel of 90 octane number, this engine has a take-off output of 1,200 b.h.p., 133⅓ b.h.p. per cylinder. Presuming that this engine were rated for operation on fuel of 100 octane number, the power per cylinder would almost certainly rise above the 150 mark, more than enough for the engine that I have in mind. Below are a few figures for this unit:—

Engine type	42-cyl. multi-bank liquid-cooled.
Angles between banks	51° 25.7".
Bore and stroke	6⅛in. and 6⅞in.
Bore/stroke ratio ..	1/1.1224.
Volume	139.4214 litres (8,508 cu. in.)
Take-off power	6,250 b.h.p. @ 2,600 r.p.m.
Power per litre	44.83 b.h.p. @ 2,600 r.p.m.
Piston area power ..	5.05 b.h.p. @ 2,600 r.p.m. per sq. in.
Maximum M.P.S. ..	2,979 f.p.m.
Weight	3 tons.
Weight per b.h.p. ..	1.075 lb.
Diameter	57in., 17.72 sq. ft. fr. area.
Crankshaft length ..	54⅛in.
Airscrew 4-blade	26ft. diam.
Airscrew disc area ..	531 sq. ft.
Max. tip speed	912,521 f.p.s. @ 670.3 r.p.m.
Reduction gear ratio	0.2578.

Mounting two of the above engines, the Douglas bomber would have an immeasurably enhanced performance. As it is, this design is ahead of its time. The point to bear in mind is that it will result in the accumulation of data of incalculable value for the future.

JOHN W. MORRISON.

London, N.W.3.

SERVICE AVIATION

Royal Air Force— *—Official Announcements*

Awards

THE KING has approved the following awards in recognition of gallantry displayed in flying operations against the enemy:—

DISTINGUISHED SERVICE ORDER

DONALDSON, SQUADRON LEADER JOHN WILLIAM.

DISTINGUISHED FLYING CROSS

MILLS, FLIGHT LIEUTENANT RANDOLPH STUART.
McNAMARA, PILOT OFFICER SIDNEY ROBERT.
PURDY, PILOT OFFICER PHILIP HANNAH.

MILITARY MEDAL

RUSSELL, SERGEANT ERNEST FREDERICK WILLIAM.

Sqn. Ldr. Donaldson was in command of a Gladiator squadron during operations at Aandalsnes which carried out numerous successful attacks on enemy aircraft, and on one day alone accounted for 14 enemy aircraft, six being shot down and eight others put out of action.

Flt. Lt. Mills was one of the flight commanders of a squadron in Norway. During an enemy bombing attack he remained in his cockpit and took off under machine-gun fire. He assisted in destroying one Heinkel IIIK and attacked eight others and three Junkers 88. P/O. McNamara led a successful attack on a Heinkel IIIK, and after landing from this engagement he also displayed bravery during an enemy bombing attack by remaining in his cockpit to take off again under machine-gun fire. P/O. Purdy also led a successful attack against Heinkel IIIK aircraft. He remained in his cockpit while subject to a bombing attack by three enemy machines, and abandoned his aircraft only when it was set on fire. He received serious burns, but insisted on helping to start two other aircraft in the face of enemy machine-gun fire.

Sgt. Russell displayed great courage and devotion to duty during the operations of his squadron in Norway. Much of his work was on rearming the squadron aircraft and was performed while subjected to bombing and machine-gun fire.

POLISH COMMANDER. Group Capt. Stachon, the Commanding Officer of the Polish Air Contingent now in training in England at an R.A.F. station

DISTINGUISHED FLYING CROSS

CLAYTON, ACTING FLIGHT LIEUTENANT GARETH THOMAS BUTLER.

In April, 1940, this officer was the leader of a sub-formation undertaking bombing operations against Stavanger aerodrome. He pressed home his attack at a low altitude in the face of heavy anti-aircraft fire and attacks by enemy fighters and succeeded in dropping his bombs among a number of German aircraft. On the return flight he was attacked by a Messerschmitt fighter for sixty-five minutes and it was only by his determination, skill and courage that he managed to bring his aircraft safely to his base. Flt. Lt. Clayton has done magnificent work since the outbreak of the war and his leadership and courage have always been of the highest order.

DISTINGUISHED FLYING MEDAL

YEOMANS, CORPORAL LEONARD.

In April, 1940, this airman was air gunner of an aircraft engaged in bombing operations against Stavanger aerodrome. On the return flight his aircraft was attacked for sixty-five minutes by Messerschmitt fighters but by his skill in the handling of his gun and his accurate instructions to the pilot when to take avoiding action, he was to a great extent responsible for the safe return of his aircraft. Throughout the combat Cpl. Yeomans showed great coolness and courage.

MAYOR, AIRCRAFTSMAN, 2ND CLASS, JOHN RICHARD.

In April, 1940, this airman was air gunner in one of a formation of three aircraft attacked by Messerschmitt fighters for thirty-five minutes. As a result of his accurate fire he disabled one of the engines of an enemy fighter and undoubtedly saved his aircraft from being shot down. In the course of the engagement his aircraft was struck many times and although his turret was put out of action, he succeeded in firing a further burst at the enemy. This was Aircraftman Mayor's first occasion in action but he operated his gun with very great skill and showed determination, coolness and courage of the highest order.

DISTINGUISHED FLYING CROSS

BEAMISH, SQUADRON LEADER CHARLES ERIC ST. JOHN (26024).
SMITH, FLIGHT LIEUTENANT CHRISTOPHER DERMOT SALMOND (33287).
SHEEN, FLYING OFFICER DESMOND FREDERICK BURT (39474).
SMYTH, FLYING OFFICER JOHN PATRICK STRACEY (37430).
WEIGHTMAN, PILOT OFFICER DOUGLAS DENNISON (41084).
WILLIS, PILOT OFFICER DAVID ALEXANDER (40331).

DISTINGUISHED FLYING MEDAL

REID, SERGEANT JOHN ANTHONY MAWSON (740945).
NEWBY, LEADING AIRCRAFTMAN JOHN EDWARD (543303).
WEBSTER, LEADING AIRCRAFTMAN ARTHUR HENRY (524040).

The above awards are for gallantry and devotion to duty in the execution of air operations.

One of these officers is decorated for his personal leadership on offensive patrols over the North Sea and in patrols co-operating with searchlights. He has set a very high example to his squadron.

Another officer led his section of three aircraft against a considerably superior number of enemy aircraft, forced one into the sea and inflicted damage on another. Later he led a section of two aircraft against seven of the enemy and, although wounded in the leg and ear, he continued the attack.

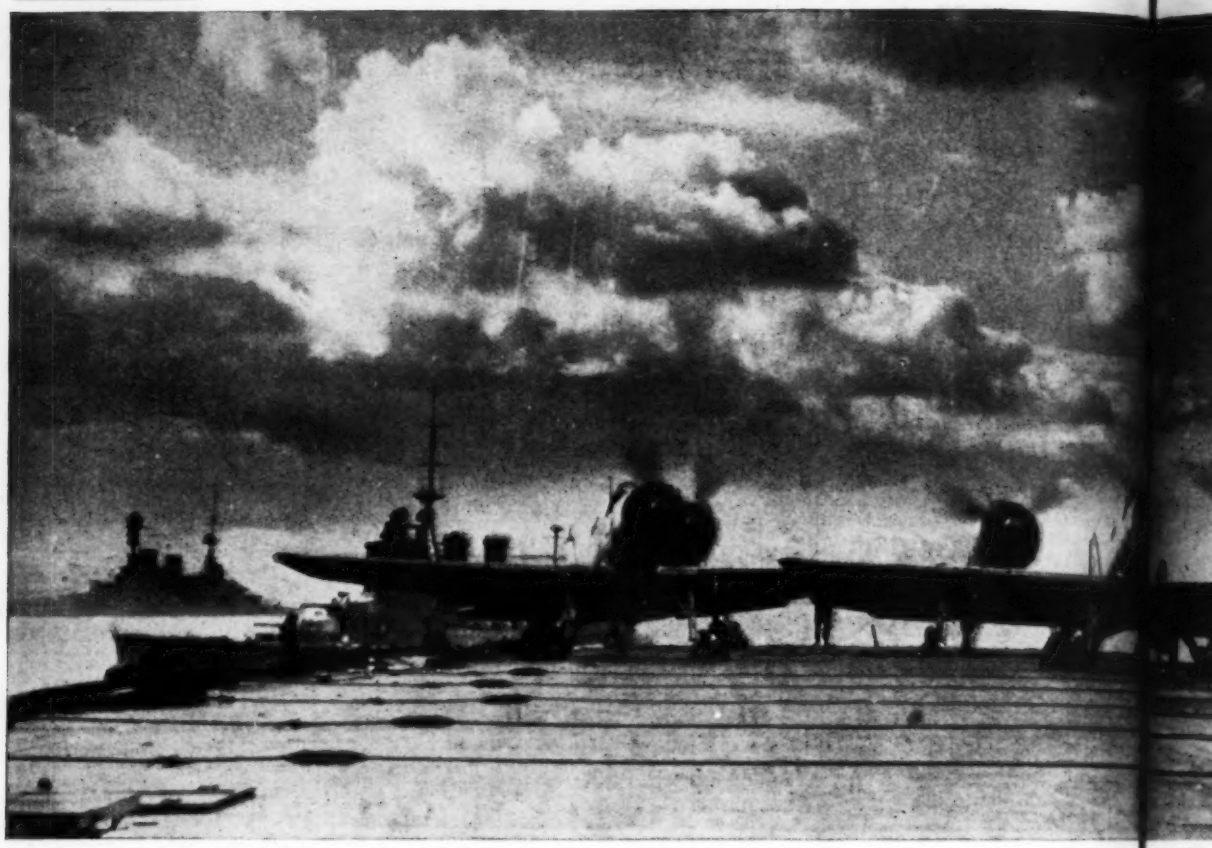
One pilot on patrol over the North Sea attacked two Dornier 18 flying boats. One was considerably damaged and unlikely to have reached its base.

A leaflet raid over Berlin gave another officer his opportunity which led to an award. Both his wireless operators collapsed, owing to the altitude at which the aircraft was flying. He dragged them to his cabin, afterwards baling out leaflets until he in turn collapsed.

A Leading Aircraftman who is decorated was rear gunner of the aircraft which attacked the Dorniers. He manipulated his turret with great skill and determination, displaying courage of a high order.

FOR GALLANTRY. P/O Derek French and F/Os Michael Homer and W. Mulloy after receiving their D.F.C.s from the King at Buckingham Palace.

Service Aviation



UNPOPULAR IN THE GERMAN NAVY are the Blackburn Skua fleet fighter dive-bombers. A flight of these is seen ready to take off from the deck of an aircraft carrier. These machines have lately distinguished themselves in operations all along the Norwegian coast where they have bombed Nazi warships and Stores.

Casualties

THE Air Ministry regrets to announce the following casualties on various dates:—

KILLED IN ACTION.—A/C.1 D. Burnside (551796); Sgt. R. F. Carter (563527); Sgt. W. Cuthbert (516395); F/O. H. G. Graham-Hogg (39516); Sgt. J. R. Proctor (515376); A/C.1 J. Shuttleworth (626490); Sgt. J. Windsor (580294).

PREVIOUSLY REPORTED "MISSING," NOW REPORTED "KILLED IN ACTION.—L.A/C. E. W. J. Picot (364162)

PREVIOUSLY REPORTED "MISSING, BELIEVED KILLED," NOW "PRESUMED KILLED IN ACTION."—A/C.2 W. H. Fiddock (619855).

PREVIOUSLY REPORTED "MISSING," NOW "PRESUMED KILLED IN ACTION."—Sgt. R. A. Bigger (580320); Sgt. G. J. Burrell (510603); A/C.1 T. Fullerton (522192); A/C.1 A. F. Hill (545939); A/C.1 A. B. Macdonald (551388); A/C.1 J. A. Topham (551613); P/O. P. E. W. Walker (70706).

WOUNDED OR INJURED IN ACTION.—Sgt. C. N. S. Campbell (580306); F/O. P. Walker (39953); Sgt. G. Whitlam (514589).

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—P/O. A. E. Evans (41162); F/O P. F. Templeman (39767)

MISSING, BELIEVED KILLED IN ACTION.—Sgt. E. R. Clarke (564585); L.A/C. J. H. Edwards (540912); Sgt. G. C. Perry (581005); F/O. K. R. H. Sylvester (39907).

MISSING.—A/C.1 A. Bailey (552060); Sgt. V. H. Barr (740019); Sgt. R. H. J. Battrick (516469); L.A/C. E. Beynon (523511); Flt. Sgt. J. W. L. G. Brent (355953); L.A/C. A. R. S. Brown (531388); Sgt. P. C. Cunningham (580784); Sgt. E. Davison (563790); L.A/C. T. Dobson (535582); A/C.1 E. B. Doherty (627157); Act. Sqn. Ldr. K. C. Doran, D.F.C. (37467); Sgt. D. W. Edmunds, A.F.M. (513935); P/O. H. C. F. Fenton (42493); Sgt. G. E. Goad (563876); L.A/C. A. J. P. Golder (522805); Sgt. T. Gosling (566256); Sgt. N. J. Griffin (563663); Sgt. N. Haithwaite (524167); A/C.1 F. Hargreaves (619153); A/C.1 F. Harwood (625809); Sgt. J. L. Hawken, D.F.M. (564188); Sgt. J. F. Hayes (580893); A/C.2 J. Henry (630142); L.A/C. T. Hogarth (543524); L.A/C. N. Hornsby (551285); F/O. O. G. Horrigan (39525); P/O. R. F. Hoskins (43152); Sgt. P. J. Hurst (525267); Sgt. A. F. James (580961); Sgt. N. L. Jones (518847);

ARMY CO-OP.: An R.A.F. army co-operation pilot receives instructions from the Army Liaison Officer before taking off.

Cpl. J. H. Langridge, R.N.Z.A.F. (37156); A/C.1 T. W. Lerway (552657); A/C.1 D. Lilley (631565); Sgt. S. McCrossan (520724); F/O. H. G. Muller (39558); L.A/C. A. Murcar, D.F.M. (532866); A/C.1 E. G. Newby (622865); P/O. L. G. Nolan-Neylan (41455); A/C.1 M. J. O'Sullivan (621221); Sgt. E. W. A. Peachey (566141); F/O. T. V. Poltock (39115); P/O. G. A. H. Poole (76015); F/O. D. P. W. R. Robinson (39173); P/O. R. H. Sanders (41478); P/O. F. M. N. Searle (42962); A/C.1 R. J. Simpson (628649); Sgt. R. F. Vickery (530080); Act. Flt. Lt. P. E. Warne (37898); P/O. C. A. Weeks (40494); F/O. D. White (39090); A/C.2 C. C. Whitley (632190); Sgt F. A. Woodcock (564824).

KILLED ON ACTIVE SERVICE.—P/O. A. L. V. Barnes (40071); P/O. M. E. F. Barnett (36235); Sgt. C. A. L. Bevan (565468); Sgt. G. Chapman (580942); Sgt. N. R. Davidson (758213); Sgt. G. L. Dent (566320); P/O. L. S. Dixon (77348); P/O. P. de G. Fry (41170); P/O. C. D. Gordon-Wilson (76314); Sgt. D. A. Hampton (741874); Sgt T. G. Horsfield (748463); A/C.2 J. W. Kempton (629791); A/C.1 G. Lindsay (625870); A/C.2 A. C. Lucas (752319); Sgt. I. N. Murdoch (580576); Sgt. P. W. Roberson (741275); Sgt. B. J. Spencer (565344); Sgt. R. E. Wilson (565833)

PREVIOUSLY REPORTED "MISSING, BELIEVED KILLED," NOW PRESUMED "KILLED ON ACTIVE SERVICE."—P/O. J. W. Boreham (39650).

WOUNDED OR INJURED ON ACTIVE SERVICE.—A/C.2 E. A. Coates (650905); Sgt A. J. Kenny (581395); P/O. R. E. Orchard (41313); F/O. J. D. Tucker (70684).

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—A/C.2 L. F. Foster (630009); A/C.2 C. Parkin (637487).

PREVIOUSLY REPORTED INJURED, NOW DIED OF INJURIES RECEIVED ON ACTIVE SERVICE.—L.A/C. G. W. D. Carter (568628).

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—L/A. K. J. Cyster (751792); L.A/C. G. W. Patterson (523326); Sgt. K. P. Vickery (566236); P/O. D. R. Williams (42172).

DIED ON ACTIVE SERVICE.—Act. Sqn. Ldr. B. C. Adamson (06175); Cpl. J. McK. Clavering (528648); A/C.2 L. W. Elliott (973429); A/C.2 W. G. A. Hoyland (972385); A/C.2 W. Kellett (743266); L.A/C. W. R. C. Knights (404303); A/C.1 A. C. Lerigo (614754); A/C.2 S. K. Little (947680); A/C.1 H. E. Pugh (247396); A/C.1 J. Read (628775); P/O. C. R. Smith (77168); A/C.2 J. W. Wells (953769).

R.A.F. Training Reorganisation

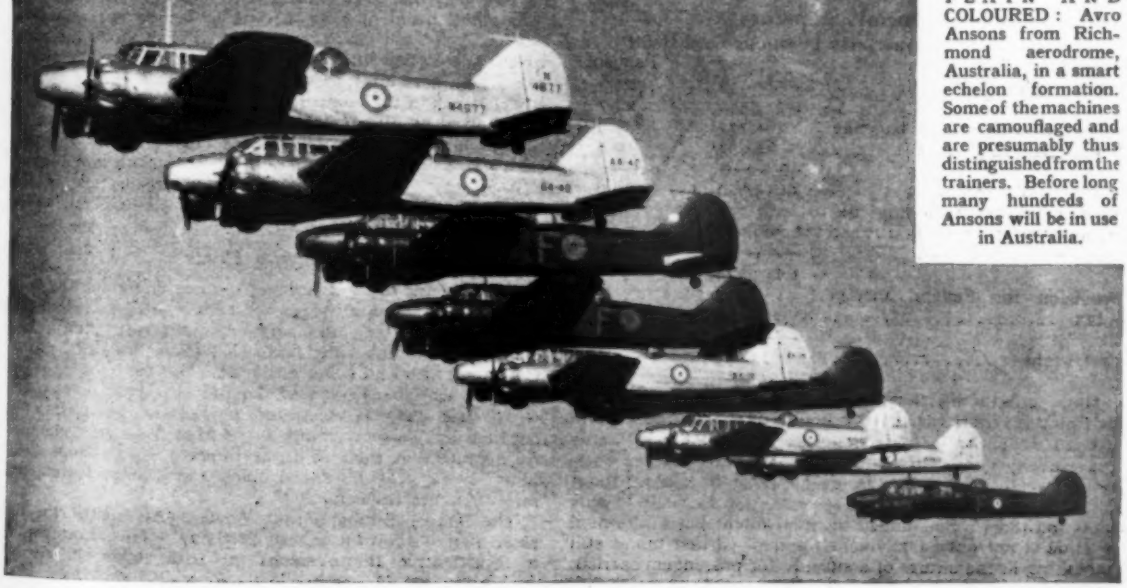
AS briefly announced in *Flight* last week, a reorganisation of the Training and Reserve Commands of the Royal Air Force is about to take place, as the result of which Reserve Command will be abolished and the training units of the Force will be divided into two commands, to be named the Flying Training Command and the Technical Training Command respectively.

A separate Reserve Command was formed in February, 1939, to relieve the amount of work devolving upon the Training Command and to enable special attention to be devoted to the problems connected with the expansion of the Royal Air Force Volunteer Reserve, whose training, being on a part-time basis, had to be dealt with on different lines from the whole-time training of the regular Air Force.

On the outbreak of war, when the Volunteer Reserve assumed full-time training, the distinction between the regulars and the reserves disappeared to a large extent. Moreover, the need for intensive training makes it desirable that personnel should, if possible, remain under one command throughout the training period.

A reversion to the old arrangement under which all types of training were controlled by one command would, however, not be practicable in present conditions, partly due to the numbers under training, and partly to the complexity of the training arrangements. It has, therefore, been decided that the most satisfactory solution was to divide the work by allocating the flying training to one command and the technical training to another.

Under this arrangement the air training of pilots and air crews will be carried out wholly under the control of the Flying Training Command, and it will also enable closer attention to be given to the important problems connected with the training of the exceedingly large numbers of highly skilled men required for the maintenance of the aircraft and equipment of the expanded Force. All establishments concerned in technical training, not essentially linked with training in the air, will be grouped under the new Technical Training Command.



PLAIN AND COLOURED: Avro Ansons from Richmond aerodrome, Australia, in a smart echelon formation. Some of the machines are camouflaged and are presumably thus distinguished from the trainers. Before long many hundreds of Ansons will be in use in Australia.

COMMERCIA

SUPERCHARGED PASSENGERS: A view inside the Strato-Clipper "Flying Cloud," looking aft. There is accommodation for 25 passengers by night and 33 by day. There is cargo space under the floor, which is placed high in the fuselage. A view of the nose of the machine is on the opposite page

UNIT COSTS of AIR TRANSPORT

Douglases at 35 Pence per Mile

THE annual report of Eastern Air Lines for 1939, when analysed, reveals some interesting figures on the cost of air transport in U.S.A. The company operates in the eastern states between New York and Miami and across to Brownsville in Texas. The fleet consists of 15 Douglas DC 3s (21 seats) and 10 DC 2s (14 seats) which flew 11,000,167 revenue-miles and 102,904,292 revenue passenger-miles. From these two figures it is evident that 9.35 seats were always occupied. Without knowing the separate mileages for DC 2s and DC 3s, the load factor cannot be calculated, but for the first six months of the year it was 55 per cent. Though 100 per cent. is, of course unattainable, there is room for improvement on 55 per cent., and if and when this figure goes up the company's profits should increase considerably.

Financial Summary

The finances for the year may be summarised thus:

Revenue:		Per cent.
Passengers	$5,523,949	72.6
Mail	1,733,540	22.7
Freight and excess baggage	294,177	3.9
Miscellaneous	62,264	0.8
	7,613,830	100.0
Running costs (including depreciation $678,128)	6,500,006	
	1,113,824	
Provision for Federal income tax	230,000	
Nett profit	$883,824	

Mail pound-miles flown amounted to 2,107 million, so that mail revenue was at the rate of 0.087 cents per lb.-mile (0.052d.). The rate of passenger revenue was 5.36 cents per passenger-mile (3.2d.). Assuming an average passenger weigh of 150 lb., to which must be added about 30 lb. of free baggage, the revenue per lb.-mile is 0.03 cents (0.018d.). So, judged on this weight basis, the mail revenue is not only a payment for mail carried but is still something in the nature of a subsidy for passengers carried. But it is not by any means a big one—the passenger pays nearly all his own fare.

If the mail were paid for at 0.03 cents, and the remainder of the mail revenue ($1,135,000) regarded as a passenger subsidy, calculation shows that the passenger would then be paying 83 per cent. of the cost of his own transport, a very considerable proportion.

The cost per mile is always a very significant figure, and in this case, for an "entirely Douglas" fleet of DC 3s and DC 2s comes out at 59.1 cents (35.2d.). It is known that the difference in cost between the two types is very small, only about 2d. per mile.

The route mileage served by the company is 5,330 miles. From the total annual mileage, and using 365 days per year, it is evident that the whole route has an average of 2.83 return trips over it each day.

The nett profit of $883,824 was sufficient to pay a dividend of $2.06 per share, as compared with $0.85 for 1938. Profit was earned during each month of 1939. The airline employs a staff of 1,378 and encourages them to become stockholders in the company, an example which could well be followed by all companies, as it helps the staff to realise that each one of them really does belong to the organisation. It is evident that the employees appreciate this, as 33 per cent. of them have availed themselves of the privilege and they make up 29.5 per cent. of all stockholders.

Running Costs

The analysis of total running costs is valuable, and is as follows: Salaries and wages, 41.1 per cent.; petrol and oil (exclusive of taxes), 10.6; depreciation, 10.1; taxes, 7.0; overhaul materials 6.8; rent, 5.0; insurance, 4.6; advertising, 3.6; and all other costs, 11.2 per cent.

No indication is given of the life of engine or airframe which has been assumed for depreciation purposes, but another air transport company, United Air Lines, changed its depreciation rates as from January, 1940, from 4,000 hours and 4 years, to 6,000 hours and 5 years for engines and airframes respectively.

The Transcontinental and Western Air report for the same period shows a loss of $188,827. This, however, is a considerable improvement on 1938, when a loss of

AVIATION

$749,355 was sustained. Though T.W.A. received more for mail than Eastern, and nearly the same from passengers, its cost per mile, 67 cents (39.8d.), was higher for the 12,097,962 revenue-miles flown. The accounts are summarised thus:

		Per cent.
Revenue:		
Passengers	$5,195,789	65.6
Mail	2,403,724	30.4
Freight	222,647	2.8
Miscellaneous	94,483	1.2
	$7,916,643	100.0
Running costs (including depreciation $935,651)	8,105,470	
Nett loss	$188,827	

New Managing Director

MR. J. S. WILLS has been appointed managing director of Great Western and Southern Air Lines, Ltd.

Mails to S. Africa

THE Postmaster General announces that the England-South Africa air mail service now operates twice instead of once weekly; the latest time of posting air mail correspondence at the Head Post Office, London, E.C.1, for South Africa, Northern and Southern Rhodesia and Nyasaland for the two services is noon on Tuesdays and Fridays respectively.

Radio Ranges in America

THE Civil Aeronautics Authority has about 260 "radio range" stations under its control, and has a constant maintenance job keeping the direction of the beams within the tolerance of 1.5 degrees which it has set as the maximum allowable. Routine tests, using 84 impedance measuring units, are made by the regional inspectors every three months except when emergency checks are required following a pilot's report indicating inaccuracy.

Soviet Air Transport

SOVIET civil aviation will increase its activities during 1940 and it is expected that the total of ton-kilometres flown will be 35 per cent. greater than last year. The international lines, Moscow to Berlin, Stockholm and Sofia, will be maintained and new lines, Kiev-Rostov-Lutsk (254 miles) and Kiev-Tarnopol-Stanislawow line (329 miles) will be established.

A service at high altitudes, equipped with oxygen apparatus, between Irkutsk and Moscow is spoken about.

A big programme of special work is also in hand, such as combating malaria in the Caucasus, Central Asia, Ukraine, the Kursk and Voronezh Provinces. Aeroplanes will sprinkle chemicals over an area of 4,580,000 acres of swamps and water expanses to exterminate the malaria-carrying mosquito. Locusts also will be attacked over an area of 1,394,000 acres, and cotton and sugar-beet pests over an area of 828,000 acres.

Air Transport in the Finnish War

AIR traffic was operated despite very difficult circumstances from the first day of the war throughout the entire period of Russo-Finnish hostilities by Swedish A.B. Aerotransport and Finnish Aero O/Y. Two daily connections were established by Aero O/Y between Stockholm and Åbo and one line was flown by A.B. Aerotransport from Stockholm via Sundsvall to Vasa in Middle Finland. Of special interest is the fact that the two lines to Åbo were operated by the same two Junkers Ju 52 planes the whole time and by the same two Finnish pilots.

During the war period November 30, 1939, to March 13, 1940, 359 flights were made between Stockholm and Åbo. In addition, 6 flights between Stockholm and Åbo had to be cancelled on account of bad weather and 2 flights on account of air raids on Åbo. The number of passengers carried between Stockholm and Åbo totalled 3,904, out of which 117 were children of less than 3 years of age. Space not needed for passengers was taken up by freight and every trip was full to capacity.

On November 15 a new service from Stockholm to Sundsvall and Vasa was started by A.B. Aerotransport.

On this line 135 flights have been made, out of which only one had to be definitely cancelled on account of bad weather. Eight flights between Sundsvall and Vasa had to return and were delayed, 4 on account of the weather and 4 on account of air raids. Of a total of 1,266 passengers carried, 77 were less than 3 years of age. In addition, 1,034 children were evacuated by air from Vasa to Sundsvall in 32 extra flights made by A.B. Aerotransport. Planes used on the Vasa route and for the extra flights Vasa to Sundsvall were Junkers Ju 52.

Belfast—Liverpool—Glasgow

RAILWAY AIR SERVICES resumed flights from Belfast to Liverpool and Glasgow on May 6. The schedule provides for one flight in each direction each weekday on the two routes. Actual flying time between Liverpool and Belfast is 95 minutes and between Glasgow and Belfast 60 minutes. Passengers must be in possession of exit permits. The time-table is as follows:—

Belfast (York Rd.)	Liverpool (Lime St.)	Glasgow (Cen. Sta.)
Dep. 9.55	Arr. 13.05	
Arr. 18.20	Dep. 15.15	
Arr. 11.00		Dep. 8.30
Dep. 17.15		Arr. 19.45

Fares to Channel Islands

JERSEY AIRWAYS announce that, owing to war conditions, they are reluctantly compelled to raise their fares to the Channel Islands by 5 per cent. as from May 15. Inter-island fares will at present remain unaltered. The new fares, airport to airport, are as follows:—

	Single	Return
Shoreham-Jersey or Guernsey	63s.	105s.
Guernsey-Jersey	15s.	25s.
Guernsey-Alderney	15s.	25s.
Jersey-Alderney	22s. 6d.	37s. 6d.

Future of Inverness Aerodrome

INVERNESS Municipal Aerodrome may still attain something of the importance which was hoped for it before the war. Conversations have taken place between the Air Ministry and Sir Murdoch MacDonald, M.P. for Inverness-shire, Provost Hugh Mackenzie and Mr. James Cameron, town clerk. Nothing has been definitely decided, but it is considered almost certain that the Ministry's modified interest in the future of the aerodrome is assured. It will be recalled that the Ministry evinced much interest in the Longman Aerodrome before the outbreak of war. Afterwards constructional work on the new terminal buildings, estimated to cost about £16,000, was stopped.

Recently the Ministry intimated that it was no longer interested in the future of the aerodrome. It was because of this that the Town Council asked for an interview for its representatives. One member of the council told our correspondent on Friday that, while the members of the council felt deeply disappointed that the full co-operation of the Ministry could not be expected, there was considerable cause for satisfaction in the fact that the Ministry had now decided not to ignore Longman altogether.

WAR in the AIR

Total War Starts : Holland and Belgium Invaded : Norwegian Evacuation Debated in Parliament

MR. CHAMBERLAIN, Prime Minister, made his promised statement on the Norwegian campaign to a crowded House of Commons on Tuesday, May 7th. He said that when he spoke last Thursday he could give only an incomplete account of the operations in Southern Norway, because we still had to withdraw troops from Namsos. That was bound to be even more dangerous than the withdrawal from Aandalsnes, both on account of the larger number of men to be taken off and of the fact that it would be possible for the Germans to bring there the whole available force of their bombers. Now he was able once again to pay his tributes to the very remarkable skill of our naval and military forces who managed to effect a withdrawal in the course of one single short night without suffering any loss in the operation.

The danger which they were running was illustrated by the fact that early on the following morning the Germans discovered that the troops were returning in their ships, and they sent a force of some 50 bombers to attack them. Considering that this convoy was outside the range of our fighters and that it had to depend, therefore, solely upon the anti-aircraft fire of the ships, we might count ourselves fortunate that we did not lose more than one British and one French destroyer. The men from Namsos and those from Aandalsnes were now back again, and the campaign in Southern Norway was at an end.

He then went on to point out that no very large forces were involved, in fact, just over a division, and these were just an arrowhead to hold strategic points until a regular striking force arrived. The local air superiority of the Germans, owing to them holding all the established air bases, rendered the maintenance of our lines of communication impossible and the decision, rightly or wrongly, was made to withdraw the troops from the Namsos and Aandalsnes areas. The striking force was never sent.

Reason for Failure

LASTLY, there was the question: Was it right, when we had decided that our operations could not capture Trondheim, to withdraw, or could we have reinforced those we had already in Norway while they were making their further attempt? He believed it was right to make the first attempt and equally right to withdraw troops when it was clear that the plan would not succeed.

The failure of the plan was due to two factors. First, our inability to secure aerodromes from which to operate our fast fighters; secondly, the rapid arrival of German reinforcements. We always believed that if our troops could get ashore they would not suffer heavy casualties from the air, and, in fact, that proved to be the case. But the absence of fighters enabled the enemy to attack our communications and hindered reinforcements, while his own land communications enabled him to bring up an ever-increasing superiority of strength.

It became clear to us that we could only maintain our forces in the Trondheim region by such a concentration of men and materials and aircraft as would have drawn off altogether an undue proportion of our total resources, and in these circumstances we decided that we could carry on the campaign in Norway elsewhere with greater vigour and effect. So, thanks to the skill and courage of all three Services, we successfully withdrew all our forces from the Trondheim area.

In the debate which followed, the Air Minister, Sir Samuel Hoare, outlined the work of the bomber squadrons in attacking the enemy aerodromes in Norway, Denmark and Germany, and went on in these words to describe the wonderful effort made by a squadron of Gladiators to establish themselves on a frozen lake.

It was a story of fine achievement which should dispose of the rumour that owing to bad management the machines had no opportunity to operate. Reconnaissance parties were sent out with the first troops that went to Aandalsnes to search for level ground which could be used as landing places for aircraft. Mr. Morrison had asked why searches were not made before. One reason was that the only level spaces in the neighbourhood were frozen lakes, and as the thaw was beginning it was impossible to say a day or two before whether a particular lake would take aircraft.

One suitable lake was found, which was swept clear of snow to form a runway, and the necessary supplies of

Some views secured by British Paramount News at the French bombing school at Cazaux. At the top practice bombs are being loaded; the second view shows a formation of Amiots, which are used as instructional aircraft; and finally live bombs are leaving the wing racks.

ammunition and petrol were provided. Within a week it was ready to receive aircraft. A primitive aerodrome there could be used by skilled and determined airmen. As soon as the landing ground was ready the squadron of Gladiators, the pilots 18 in number, flew from the deck of an aircraft carrier 180 miles from land, in a thick snowstorm, and by 10 p.m. that day the first patrol was in the air.

It was credibly stated that something like 80 bombers took part in the attack and they were over the lake continuously for about 15 hours—so continuously that it was hardly possible to speak of separate attacks. Tons of high-explosive bombs were dropped on the surface of the aerodrome. During that period there were 37 combats and six German machines were brought down close to the lake and another eight German machines were brought down in the near vicinity. A squadron leader and a flight lieutenant had told him the previous day that they were confident that no fewer than 30 German machines were put out of operation in the course of 15 hours. This instance showed the quality of the British fighter, and with air bases properly defended he was quite confident that the course of events of the past four weeks would have been entirely transformed. His Majesty the King had conferred decorations on this very gallant squadron.

Long-distance Reco.

THE longest reconnaissance flight to date goes to the credit of the New Zealand Bomber Squadron of the Royal Air Force. In a Vickers Wellington fitted with long-range petrol tanks they left Scotland at daybreak for a trip to reconnoitre the whole Norwegian coast to the Lofoten Islands and the Vest Fjord to Narvik. Heavy rain and snowstorms were encountered on the outward journey to the north and for a long time they were flying in 27 deg. of frost.

Describing his experiences after the flight, the pilot said: "As we reached the Norwegian coast we got ready for anything.

"The wireless operator manned the front gun; the second pilot stood at the astro-hatch, acting as a fire-control officer, and the rear gunner took his place in his turret.

"Norway, covered in deep snow, was an awe-inspiring

The French remain faithful to the balloon for army co-operation aircraft though they have, in addition, normal army co-operation aircraft. Part of a contingent of German parachute troops is shown below. These men were used in Norway and are reported to have been landed, wearing Dutch uniforms, in Holland.

sight, and at the time any land was very welcome to us.

"Our real work had now begun, though the weather was steadily deteriorating. There was a high wind and we were flying in and out of snow and sleet about 300ft. above the sea. There were such terrific bumps that the gunners frequently banged their heads as they were flung upwards out of their seats.

"We met an enemy aircraft as we went towards the Vest Fjord, but he sheered off when he saw us. We flew up the fjord through driving snow at only 200ft. The clouds and cliffs seemed to be closing in on us, and when we got to the end we swung round, made a sharp turn and continued the reconnaissance southward down the coast as far as Kristiansand. Then we turned for home.

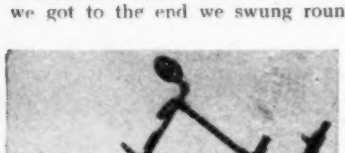
"Up to this time none of us had eaten any of the rations we carried. We had been too excited about doing the job, but now we all had a cup of hot coffee and some sandwiches.

"The trip back was without incident apart from the weather. We saw British Naval units in the North Sea, circled round them and exchanged signals by Aldis lamp. We had seen a couple of British destroyers and a merchantman at the entrance to one of the fjords.

"We had a strong wind against us on this homeward trip, and we were very glad to see the Shetlands as we approached Scotland.

"The crew comprised my second pilot, a Sergeant Observer who acted as navigator, an L.A/C. who was the wireless operator, an aircraftman who was the air gunner, and myself as captain.

"The whole crew was interchangeable. Anyone could do anyone else's job, even to piloting, at a push. There was no automatic pilot in the aircraft. The second pilot and I, before we finished, had shared 14½ hours at the controls over a distance of more than 2,000 miles."



GERMAN ANTI-AIRCRAFT DEFENCE: On this page are illustrated the four types of gun which form the basis for Germany's A.A. defence. The twin guns on the left are of rifle-calibre and belt-fed. Below are the 20 mm. gun which, like the 37 mm. model beneath it, is clip fed. Bottom right is the standard 88 mm. gun. Weapons of larger calibre are known to have been evolved but it is not thought that these are in use in very large numbers.

Holland and Belgium Invaded

THE storm burst over Holland and Belgium before dawn on Friday, May 10. The Dutch frontier was crossed at 3 a.m., and Belgium territory invaded an hour and a half later. Large numbers of parachute troops were dropped near strategic points, and transport aircraft landed troops on the beach near The Hague and on the Rotterdam aerodrome at Waalhaven. In The Hague they took possession of several buildings and the aerodrome, and at Waalhaven they were not dislodged until after an intense bombardment by the R.A.F. It later passed again into German hands. An attempt was also made to secure Schipol aerodrome by landing troops by air, but this was frustrated by the placing of large numbers of drainpipes all over the landing area. Since the landing at Schipol proved abortive, it was heavily bombed by the Luftwaffe.

The Advanced Air Striking Force of the R.A.F. in France immediately went into action, harassing the German lines of communication; the enemy, in reply, bombing our aerodromes in France. Obviously, every precaution is taken to avoid giving any news which may be of use to the enemy, and so the Air Ministry communiqué issued on Friday evening was laconic. It stated: "R.A.F. aircraft have to-day undertaken offensive operations against aerodromes occupied by the enemy in Holland."

On the Western Front British air successes were summarised in the following statement issued from the headquarters of the British Force in France:—

"In the course of to-day's operations on the Western Front, the R.A.F. have been constantly in action. Our

reconnaissance aircraft have been operating over a wide area. Enemy troops have been attacked by our bomber squadrons.

"Wherever German bombers have been encountered our fighter squadrons have engaged them. Reports indicate that in the course of these combats numerous enemy aircraft have been destroyed.

"Several of our aerodromes have been bombed. Little damage has been done and no lives have been lost."

It was officially stated that eleven French towns were bombed with considerable civilian casualties, but it is thought that military targets were aimed at. Saturday saw an intensification of the air war. The R.A.F. bombed Waalhaven all night, and further harassed troop concentrations and supply trains. Parachute troops were dropped in considerable numbers during the night, and it was officially confirmed that a number of these were wearing civilian clothing or Allied military uniform. Brussels and Amsterdam were raided, and there was also some further bombing of French towns.

In these raids on French towns 148 civilians were killed and 337 injured. The Germans kept up their savage attacks on roads and railways. Obviously in such a terrific clash between armies and air forces enormous numbers of machines must have been lost, and fantastic figures have been quoted. It will be some while before truthful figures become available.

An Air Ministry communiqué, issued at one a.m. on Monday morning, May 13, revealed for the first time the use of Boulton Paul Defiants in action. They appear to have been very successful. The communiqué reads:

"A fuller account can now be given of the operations of the R.A.F. since Saturday morning.

"Extensive reconnaissances show that much damage has been done by our aircraft to aerodromes in Holland used by the enemy advancing troops, and the enforced use of emergency landing grounds has caused the enemy very heavy losses in aircraft in addition to those destroyed by attacks from the air.

Fourteen Troop-planes Damaged

"FOURTEEN out of sixteen troop-carriers observed on one landing ground alone were seen to be damaged.

"In spite of intense anti-aircraft and fighter opposition the communications of the large German mechanised forces now advancing in Belgium and Luxemburg have been dislocated by the destruction of both the road bridges at Maastricht. Railway communications have also been interrupted at that point and roads damaged.

"Important road and rail damage were also caused in Germany between the Rhine and the Dutch frontier, including damage to supply trains and a railway station.

"It is noticeable that the enemy is now finding it necessary to employ much larger fighter patrols. Some of our fighters have engaged patrols 20 strong.

"Nevertheless our fighters' losses have not been heavy and enemy aircraft have been unable to prevent our troops from moving rapidly to the aid of our Allies.

Spirited Defence

"FURTHER attacks have been made by the enemy on our railroads in France but without causing serious damage. Our machine-gun posts put up a spirited defence and shot down a number of enemy bombers.

"Fighter aircraft patrolling The Hague and Rotterdam areas engaged and shot down two enemy fighters and two reconnaissance aircraft. Three other enemy aircraft were shot down by Defiant fighters off the Dutch coast.

"Two unidentified aircraft approached the East Coast and one Junkers 88 was intercepted at a great height and driven down. Our reconnaissance aircraft engaged a Heinkel and shot it down in the sea off the Dutch coast.

"The enemy's losses in aircraft are undoubtedly very large. It is impossible to assess them closely. Forty-five are known to have been shot down in combat by the R.A.F. since Saturday morning. It can safely be assumed that as many again have been destroyed or damaged.

"On all fronts our pilots and crews have pressed on their attacks religiously and with courage. Losses have necessarily been incurred in these hazardous and vital operations.

"Altogether some 35 of our aircraft have so far failed to return, but some of them are known to have made forced landings in Belgium and France."

In addition to the first news of the Defiant in action comes the announcement that Bristol Beauforts took part in a severe raid on Waalhaven aerodrome. A formation of these new general purpose bombers arrived and, having split up, proceeded to bomb and machine gun the targets presented to them. There was no report of any casualties to the Beauforts.

Summing up the first few days of total air war it may be said that while the German attacks are very vicious they are not as severe as had been anticipated. The Germans have always believed in putting their full weight into the first blow—in 1914 it was "Paris in six weeks"—and so, perhaps, even greater intensification may be expected.

Air War in Brief

On the first day of the invasion there was at one time over 100 machines—mostly Ju.52 troop-carriers—in the air and on the ground near Rotterdam. Numbers of parachutes, discarded by troops who had landed from the air were also seen.

* * *

For the first four days of the German invasion of Holland and Belgium it is claimed that over 300 enemy aircraft have been destroyed.

* * *

An Auxiliary Air Force Squadron whose home town is in the West of England celebrated its first day in action by bringing down 13 German machines.

* * *

A Ju.88 was despatched by a Fighter Command Hurricane off the East Coast on Friday afternoon, and a second was shot down near the Scottish coast.

* * *

R.A.F. fighters in France bagged five of the enemy machines which raided them early on Friday morning, May 13. On the same day ten enemy troop-carriers which had disembarked troops on the beach near The Hague were attacked by British bombers and long-range fighters. At least four were destroyed.

* * *

German flights raiding our aerodromes in France came in clearly marked waves. Dornier Do.17 and Do.215, Heinkel He.111 and Junkers Ju.88s were all in evidence. They mostly crossed the frontier at a great height but coming down lower for their actual attack.

* * *

During the night of May 9 some incendiary and high explosive bombs were dropped in Kent. Presumably the aircraft was on its way to bomb ships in the Downs, and dropped the bombs accidentally.

* * *

According to an Admiralty communiqué, the Fleet Air Arm have, since April 8, shot down 20 German machines off Norway, in addition to those destroyed on the ground. A further 51 have been shot down by the anti-aircraft gunfire of the Fleet.

* * *

The Fleet Air Arm have made two further attacks on the enemy at Bergen. In one attack three hits were scored on a warship, believed to be the *Bremse*.

* * *

A spectacular air battle occurred when three Hurricanes encountered a hostile formation of 30 Ju.88s and escorting Me.110s. The Hurricanes joined action, and a dog-fight ensued. Three Me.s were shot down before the British trio received reinforcements, and a further couple were destroyed afterwards. The Junkers-Messerschmitt formation was part of a force of 70 aircraft which attacked the R.A.F. zone in France.

THE INDUSTRY

Henderson Safety Tank

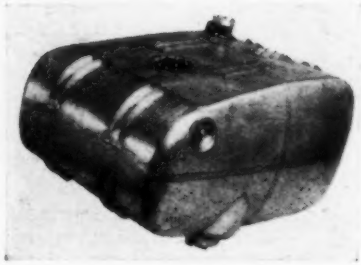
FIRE in the air or as the result of a crash, perhaps quite minor in itself, has, since the commencement of flying, been one of the most prolific causes of disaster and one of the major problems to be solved. It was in an attempt to eliminate this bugbear that the Henderson Safety Tank Co., Ltd., of Elstree Way, Elstree, Herts, embarked on a programme of research and development over nine years ago. The attempt has been very successful. So much so that the Air Ministry has insisted that all the Miles Master advanced trainers now in production are to be fitted with Henderson safety tanks further to reduce the already low figure of training fatalities.

In practically every air crash petrol tanks burst on impact, and shower highly inflammable fuel over hot engines and exhaust pipes. There are, of course, several causes of crash fires, such as short circuits in the electrical equipment, sparks struck from the ground or static discharge, but in many cases fire results from ignited engine oil, grease or loose petrol or petrol vapour. For this reason it is clear that if fuel tanks can be so constructed as to withstand impact and distortion without bursting in the event of a crash, then the risk of a major conflagration is reduced to a minimum.

The walls of the Henderson tank are built up in three layers to a total thickness of $\frac{3}{16}$in. and each layer is a complete leak-proof unit in itself. Both the inner and outer shells are of thin sheet copper sandwiching between them a continuous lining of Hencorite—a patent rubber product—which is vulcanised to both the metal casings. In effect, the tank is a flexible bag which is stabilised in all directions by the inner and outer shells. The baffles attached to the inner walls of the tank are secured by a special self-releasing device by which they become detached in the event of a crash, thereby enabling the pressure inside the tank to be evened up. Furthermore, as the tanks are fashioned without any rivets the Henderson safety tank is definitely proof against leakage and seepage, a common source of trouble in present-day tanks. The Henderson Safety Tank can be built to any shape

HOLE MADE BY ·303 AMMUNITION
1 CUT AWAY OUTER SHELL CUT BACK HENCORITE ON THREE SIDES
4 CEMENT PATCH TO HENCORITE & SOLDER TO OUTER SHELL
2 SOLDER PATCH TO INNER SHELL
3 CEMENT HENCORITE BACK INTO POSITION & TAPE CUTS

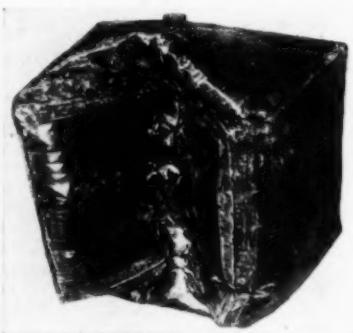
The four operations necessary to repair a bullet hole in a Henderson Tank.



Henderson construction lends itself to smooth outlines.

and has been designed to take any required stress or strain. In spite of the tank's triple skin its weight is unexpectedly low—between 1 to 1¼lb. per gallon for capacities of 50 gallons and upwards, which is little more than that for tanks employed on modern commercial aircraft.

War is only a temporary condition, and, very wisely, the Henderson Company have concentrated on the crash-proof problem, but it is gratifying to find that this self-same tank has excellent bullet-proof qualities. They have at their works a tank which was shot



Dented but not disrupted. A Henderson tank taken from a crash.

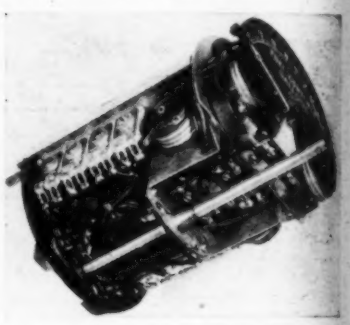
through and through some two months ago and yet shows no signs of a leak—not even a weep. The particular form of construction lends itself to very easy repair of bullet-holes; in fact, anyone who can handle a soldering iron with some skill is capable of carrying out the work. This is a very distinct advantage in the field where every hour a machine is out of commission is of profit to the enemy.

A New Fuel Gauge

WAYMOUTH GAUGES AND INSTRUMENTS, LTD., have designed a fuel contents gauge employing the principle of measuring the specific inductive capacity of the petrol or oil in the tank.

Two plates, one of which may be the usual baffle, between $\frac{1}{8}$in. and $\frac{1}{2}$in. apart and insulated from one another, are fitted vertically inside the tank, the plane of the plates being in the direction of flight. These two plates become an electrical condenser the capacity of which varies according to the area of the plates immersed in the fuel. The dashboard instrument is a direct reading electrical capacity meter.

Suitable design of the condenser plates and the use of a switch incorporated in the dashboard instrument, enables the contents of tanks of dissimilar size and shape and containing either petrol or oil to be shown on the same scale. As many as six tanks may be connected to one instrument. Current consumption is $\frac{1}{2}$ amp. at 24 volts pressure, but as low as 20 volts or as high as 30 volts can be employed without appreciably affecting the reading. There is no direct electrical connection between the tank and the electric supply—it is via a condenser—therefore there is no possibility of fire



The interior of the Waymouth fuel gauge.

being caused by sparking; only about 1/200 volt is used in the tank.

British Overseas Airways are equipping one of their DH86s with this gauge for trial on regular service, and it is hoped that official approval by the Air Registration Board will be given shortly.

The address of the company is 31, Brunel Road, Old Oak Common Lane, Acton, W.3.

NEW TITLES FOR THREE I.C.I. COMPANIES

The British Dyestuffs Corporation, Ltd., will in future be known as I.C.I. (Dyestuffs), Ltd.; Nobel Chemical Finishes, Ltd., as I.C.I. (Paints), Ltd. and the Salt Union, Ltd., as I.C.I. (Salt), Ltd. This designation will bring these three associated companies into line with the other manufacturing groups of Imperial Chemical Industries, Ltd.

The British Dyestuffs Corporation, Ltd., has been an associated company of Imperial Chemical Industries since the formation of the combine in 1927. Its up-to-date laboratories at Blackley, Manchester, have done much to make Great Britain independent of imported dyestuffs. The research covers not only dyestuffs, but rubber and medicinal chemicals, pest control, laundry and textile products.

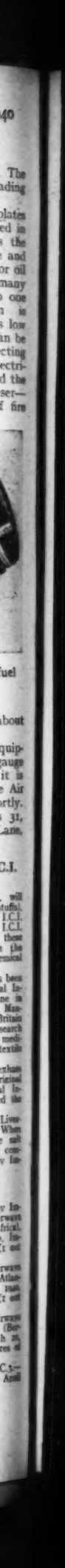
Nobel Chemical Finishes, Ltd., of Wexham Road, Slough, Bucks, was also one of the original constituent companies of Imperial Chemical Industries, Ltd. This company has developed the use of nitro-cellulose and synthetic paints.

The Salt Union, Ltd., Colonial House, Liverpool, 2, is the youngest of the I.C.I. groups. When formed in 1888 it consisted of sixty-three salt works and is now the largest salt-producing company in Great Britain. It was purchased by Imperial Chemical Industries, Ltd., in 1937.

CHANGE OF NAME

IMPERIAL AIRWAYS (AFRICA), LTD., formerly Imperial Airways (South Africa), Ltd., Airways House, S.W.1.—Name changed to Airways (Africa), Ltd., on April 15, 1940. At March 22, 1940, Imperial Airways, Ltd., held 99,995 shares of £1 out of 100,000 issued.

IMPERIAL AIRWAYS (ATLANTIC), LTD., Airways House, S.W.1.—Name changed to Airways (Atlantic), Ltd., on April 15, 1940. At March 22, 1940, Imperial Airways, Ltd., held 995 shares of £1 out of 1,000 issued.

IMPERIAL AIRWAYS (BERMUDA), LTD., Airways House, S.W.1.—Name changed to Airways (Bermuda), Ltd., on April 15, 1940. At March 22, 1940, Imperial Airways, Ltd., held 9,994 shares of £1 out of 10,000 issued.

C. F. AIRCRAFT, LTD., 25, Birchin Lane, E.C.3.—Name changed to Fane Aircraft Co., Ltd., on April 16, 1940.